Applied Hydraulics

PNEUMATICS · ELECTRICAL CONTROLS

OCTOBER/1957

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THE MAGAZINE OF FLUID POWER

AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

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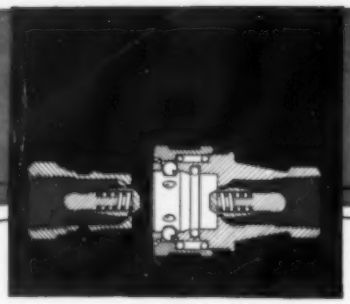
THE JANUARY 1958 DESIGNERS GUIDE ISSUE
see page 175

NEW HANNA FLO PILOT VALV



shuts off both sides of line... prevents loss of liquid, gas, or pressure.

Wherever 2-way shut-off is required...

HANSEN

QUICK-CONNECTIVE TWO-WAY SHUT-OFF COUPLINGS

FOR PRESSURE OR VACUUM SERVICE

To connect a Hansen Two-Way Shut-Off Coupling, you merely pull back the sleeve and push the Plug into the Socket. To disconnect, just pull back the sleeve. No tools required. When Coupling is disconnected, similar valves in Socket and Plug shut off both ends of line—practically eliminate spilling of liquid or escape of gas at instant of disconnection.

Hansen Series HK Two-Way Shut-Off Couplings are available with female pipe thread connections from ⅛" to 1" inclusive. Available in brass or steel. Sizes generally required for L-P Gas service have approval of Underwriters' Laboratories.

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Here's an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings—including Special Service Couplings for Steam, Oxygen, Acetylene, etc.

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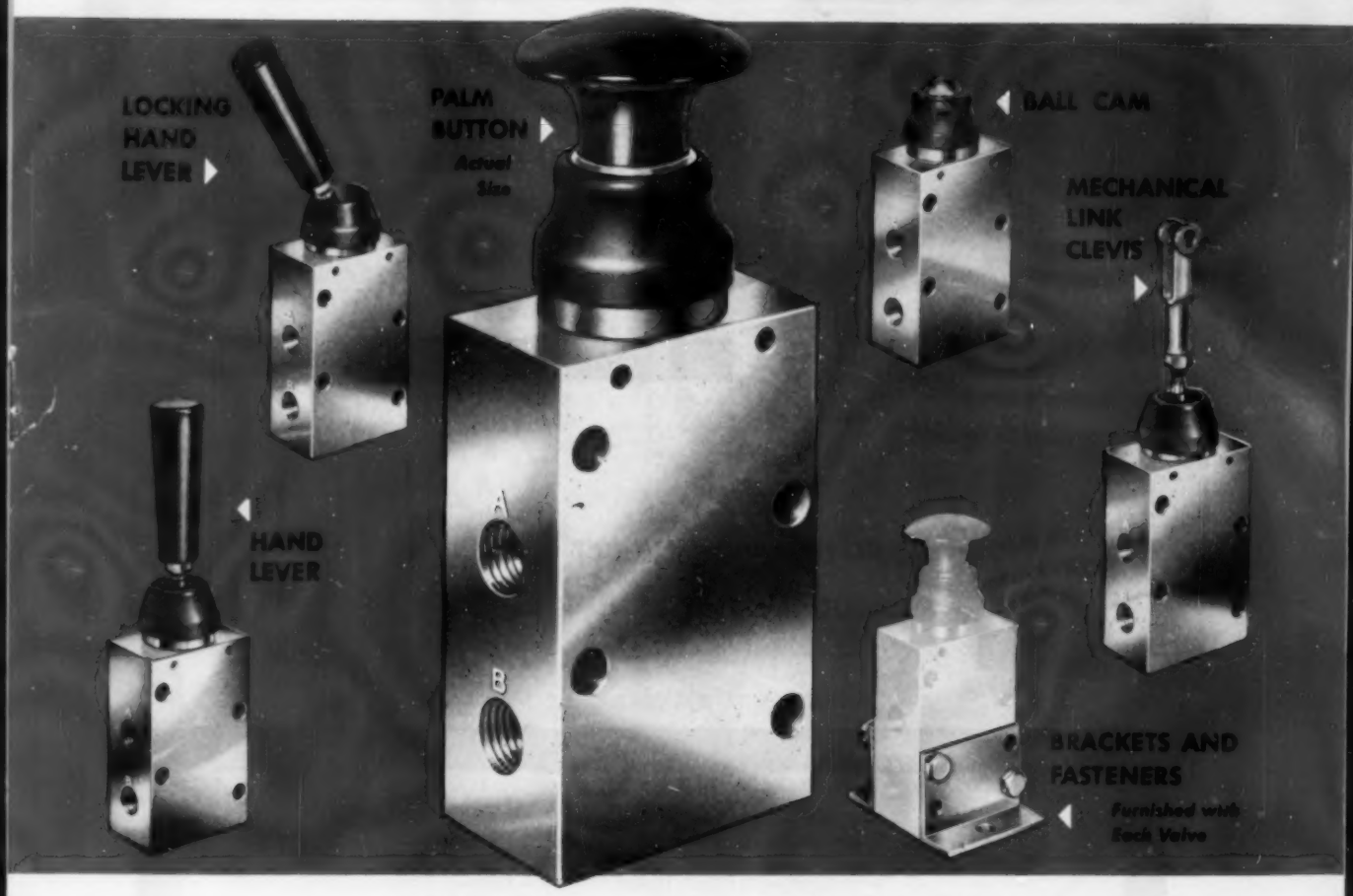
NEW HANNA FLO-PILOT VALVE has dirt-proof seal!



Hanna Flo-Pilot Valves are ¼" two- and three-way Pilot Valves for air operation to 150 psi. They are used for remote control of master valves, directional control of small single acting cylinders and for shut-off. Same valve can be used for two or three-way operation either normally open or normally closed to inlet pressure.

HANNA Flo-Pilot Valves will deliver years of dependable performance at a very low cost because they have built-in money-saving features. Every Hanna Flo-Pilot Valve is equipped with a synthetic boot which seals the valve stem and internal parts from harmful dirt and abrasive, thereby eliminating the most common cause of valve failure.

These protective boots, efficient "O" ring spool packing and nylon sleeves, are built into every Hanna Flo-Pilot Valve to save you money and assure leak-free operation even after millions of cycles.

The five actuating-heads—push button, ball cam, hand lever, locking hand lever and mechanical link clevis—are interchangeable in a matter of seconds. Spools can be changed just as quickly without disturbing the piping.

Corrosion resistant materials are used throughout. Flo-Pilot Valves have a simple, sturdy construction with anodized aluminum body, stainless steel and molded nylon parts. Valves can be conveniently mounted in any position and are furnished with brackets and fasteners. They are easy to operate, positive acting and have full capacity of ¼" orifices.

Ask your Hanna representative (see the yellow pages or Thomas Register) for complete information or *write direct for Catalog 262.*

Hanna Engineering Works

HYDRAULIC AND PNEUMATIC EQUIPMENT . . . CYLINDERS . . . VALVES

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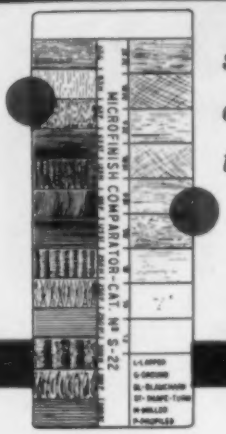
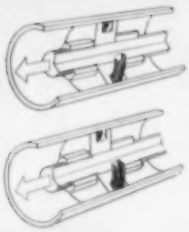
problem:



save money with a seal that needs only 60-100 micro-inch groove finish to replace O-rings that need 10-20.

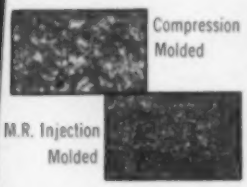
new answer:

minnesota rubber's money-saving new



Why New Design Seals Better

QUAD RINGS eliminate "spiral twist", a common cause of packing failure. At any pressure, less squeeze is required with QUAD RINGS than with O-rings. Truly effective sealing even for pressures as low as 0-5 psi. QUAD RINGS also give a positive seal under high vacuum. The 4-lip sealing surfaces reduce breakout and running friction—giving longer life. Seal perfectly even with a rougher groove finish.



Why Minnesota Rubber Seals Last Longer

QUAD RINGS are injection molded by exclusive Minnesota Rubber process. Result is increased resistance to abrasions and chemical actions due to unequalled high density. Evidence of greater density is shown here in cross sections of Standard Buna N compound, .027" x .019", magnified 240 diameters by University of Minnesota.

Free Samples and Data

Free samples of QUAD RINGS are available together with a descriptive brochure with technical information and installation data. QUAD RINGS are the result of intensive research and field testing. Made to closest possible dimensional tolerances. We urge you to inquire about this revolutionary new seal today.

QUAD RING is a Minnesota Rubber and Gasket Company trade mark

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Originators of modern rubber injection molding

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Applied Hydraulics

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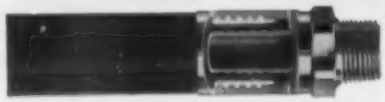
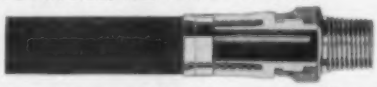
ANDY ANCHOR SAYS:

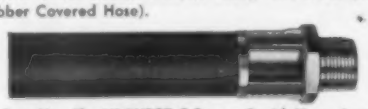
WE CAN SUPPLY THE RIGHT HOSE ASSEMBLY



Anchor Ductile Sleeve Couplings for high pressure assemblies incorporate a ductile sleeve which virtually makes the coupling a part of the reinforcing wires of the hose. Used on 2-Wire Braid, Extra Strength 2-Wire Braid, 3 and 4-Wire Braid Hose. Sizes available from ¼" I.D. 3-Wire Braid, 7000 PSI Max. Wk. Pres. to 2" I.D. 2-Wire-Braid, 1125 PSI Max. Wk. Pres.



Anchor Medium and Low Pressure Assemblies, for 1-Wire Braid Hose with a working pressure of 3000 PSI in the 3/16" I.D. size to 375 PSI for the 2" I.D. size, have an integral insert and an internally threaded shell that provide a permanently tight grip on the hose. "O" Ring Seals between swivel nuts and coupling bodies prevent leakage. Also available in Max-Flo design for greater flow capacity and in Style QW (1-Wire Braid Cotton Covered Hose) and QWR (Thin Rubber Covered Hose).



Anchor Max-Flo HI-BURST 2-Rayon Braid Hose Assemblies for medium and low pressure have couplings with integral inserts that are internally expanded as the threaded coupling shell is swaged, thus providing a positive grip. The I.D. of the coupling is substantially the same as that of the hose providing maximum flow capacity from 1250 PSI to 550 PSI Max. Wk. Pres. Available in ¼" to 1" I.D. Hose.

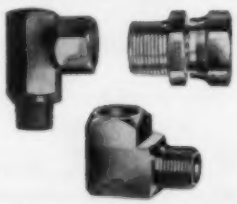
Anchor Low Pressure 2-Rayon Braid Hose Assemblies and Anchor Low Pressure Multi-Purpose Hose Assemblies are designed for maximum working pressures of 500 to 625 PSI and 200 to 250 PSI respectively. Both are made with hex brass couplings.

Anchor Max-Flo Suction Hydraulic Return Line Assemblies are made with spring steel reinforcing wire interwoven with cotton cord to produce a non-collapsible hose. Modified dovetailed locking grip on inner shell of the coupling, and barbed integral insert provide a tight grip. Available from ¾" I.D., 300 PSI Max. Wk. Pres. to 2" I.D., 100 PSI Max. Wk. Pres.

Anchor Pressed On Ductile Sleeve "O" Ring Head Couplings, for use with Anchor 4-Bolt Split-Flange halves, utilize the same tested and proved hose gripping methods used on other Anchor assemblies. Couplings are available in straight, 22½°, 30°, 45°, 60°, 67½° and 90° angles in standard and in a 360° swivel coupling. For standard and extra strength 2-Wire Braid Hose and 3-Wire Braid Hose from ½" to 2" I.D. and from 900 PSI to 3500 PSI Max. Wk. Pres. Also for Spiral Wire Suction Hose ¾" to 3" I.D., 300 to 55 PSI Max. Wk. Pres.

PRESSED ON

In the selection of hose assemblies, one of the most important factors is length of service. Anchor Pressed On Hose Assemblies are competitively priced, but their outstanding feature is the long dependable service they render. This is the result of Anchor's insistence on highest quality in material and workmanship through every manufacturing step. Experience will prove that you can always depend on Anchor for maximum service life!



ANCHOR ADAPTER UNIONS AND PIPE FITTINGS

Anchor precision-made Adapter Unions, designed for use with Anchor Pressed On and Reusable Couplings, prevent hose strains and twisting and eliminate one or more pipe thread joints.

For complete specifications on Anchor Pressed On Hose Assemblies, write for Anchor Catalog No. 101. Anchor's SAE Boss Fittings described in Anchor Catalog No. 203. Anchor Flanco, 4-Bolt, Split-Flange Couplings and Assemblies are described in Catalog No. 401. Please request specific catalog desired.

SPLIT-FLANGE HYDRAULIC HOSE ASSEMBLIES . . . featuring the Anchor Flanco, 4-Bolt, Split-Flange "O" Ring Head Couplings are described in Anchor Catalog No. 401. They are available in Pressed On style for original equipment installations — Clamp Type, for immediate repairs or special assembly installations, and Weld Type, for connecting pipe or tubing to system components having an SAE 4-bolt port boss, or for pipe to pipe connections. Widely used for high, medium and low pressure hydraulic, and for suction return applications. Anchor Flanco, 4-Bolt, Split-Flange "O" Ring Head Couplings meet SAE standard requirements shown on Page 808, 1957 SAE Handbook. Anchor Catalog No. 401 may be had by writing to Anchor Coupling Co. Inc., 370 North Fourth Street, Libertyville, Illinois.

LPG HOSE ASSEMBLIES . . . with Pressed On, Reusable and Clamp Type Couplings are described in Anchor Catalog No. 500. The Pressed On type assembly is available in three hose styles: 1-Wire Braid, Style LPW, for 350 lb. working pressure, 2-Rayon Braid, Style LP, for 350 lb. working pressure and Anchor LP51 Hose for 250 lb working

ANCHOR COUPLING CO. INC.

370 North Fourth St., Libertyville, Ill.

Branch Offices: Dallas, Tex., Plymouth, Mich.

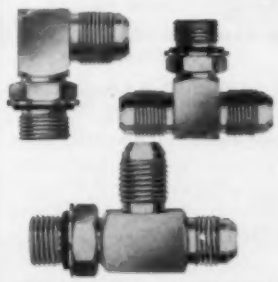
Pressed on or Reusable...

ANCHOR HAS BOTH

REUSABLE

Anchor Reusable Couplings are designed for a wide variety of hose styles to suit virtually any hydraulic, LPG or Anhydrous Ammonia need. They are all similar in their easy, free installation, making them ideal for quick, emergency repair. The long, trouble-free service they render is the result of Anchor's rigid quality control system under which all Anchor products are manufactured. Whatever your hose requirements, Anchor can fill them efficiently and economically.

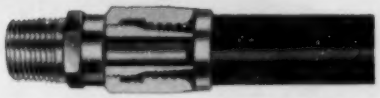
Anchor "O" Ring Head Clamp Type Reusable Couplings for use with Flanco 4-Bolt, Split-Flange Halves are available for use with 2-Wire Braid Hose, Extra Strength 2-Wire Braid Hose, 1-Wire Braid Hose, Spiral Wire Suction Hose and Medium Pressure HI-BURST 2-Rayon Braid Hose. "O" Ring Head Clamp Type Coupling Stems, for use with Clamp Type Reusable Couplings are available in standard angles from 0° to 90° in sizes from ½" to 3" I.D.



ANCHOR SAE STRAIGHT THREAD "O" RING BOSS ADAPTERS

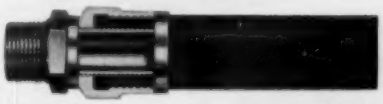
Designed for use with new SAE Boss, they insure positive leak-proof connections without excessive tightening and thread distortion. Now supplied with factory applied back up washer that prevents "O" Ring extrusion.

For complete specifications and engineering data on Anchor Reusable Coupling, write for Catalog No. 301. Anchor Adapter Unions and Pipe Fittings are covered in Catalog No. 203.

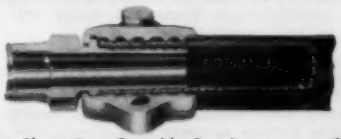


Anchor High Pressure Reusable Couplings for 2 and 1-Wire Braid Hose require no special tools or replacement parts for attachment to hose. Emergency repairs are completed on the job with minimum down time. Couplings are streamlined and have a threaded insert and shell that provides a positive, leak proof grip. Available for ¼" to 1" I.D. 2-Wire Braid Hose, working pressures from 5000 PSI to 1875 PSI, and ¼" to ¾" I.D. 1-Wire Braid Hose, working pressures from 2750 PSI to 1250 PSI.

Anchor "Duloc" Reusable Couplings for medium and low pressure, Style QW 1-Wire Braid Cotton Covered Hose, and Style QWR with thin rubber cover over cotton braid, are streamlined and easy to assemble in confined spaces. The Anchor Hex Drive Assembly Mandrel makes attachment easy. Duloc Couplings are made for 3/16" to 1-13/16" I.D. Hose for 3000 PSI to 350 PSI Max. Wk. Pres.



Anchor HI-BURST 2-Rayon Braid Hose Assemblies with Reusable Couplings are made in sizes ¼" to ¾" I.D. for working pressures from 1250 PSI to 750 PSI Couplings require no special tools for attachment and no skiving of hose cover and have a firm, blow-off proof grip. Standard 2-Rayon Braid Hose Assemblies with similar Reusable Couplings are available in ½" and ¾" I.D. for 625 and 500 PSI working pressures.



Anchor Clamp Type Reusable Couplings are available for all types of hose for low, medium and high pressure service. Easily applied, with the help of only a pair of common automotive wrenches, these clamp type couplings are excellent for emergency repair or experimental plumbing of equipment. Hose sizes available: 2-Wire and 3-Wire Braid High Pressure and 1-Wire Braid Medium Pressure Hose from ¼" I.D. to 2" I.D. Also available for Spiral Wire Suction Hose from ¾" to 2" I.D. and 2-Rayon Braid Hose from ½" to 1" I.D.

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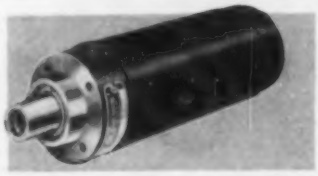
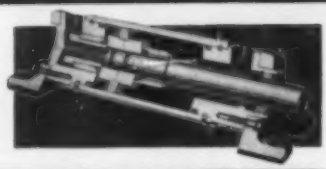
pressure. Style LPG carries UL approval and has rayon braid reinforcement. Also described in this catalog is a new Dual Pressed On or Reusable Hose Assembly, designed for use on LPG Service Trucks, that consists of two standard hose assemblies joined by neoprene covered aluminum clips. Lighter weight and replacement of a single hose at a time are advantages offered. For use on loading docks, for connection to tank cars and transfer trucks, is a new hose assembly with a 3½" Acme Thread, offering a lighter weight connection. Ask for Catalog No. 500. Anchor Coupling Co. Inc., 370 North Fourth St., Libertyville, Ill.

AUTOMOTIVE, AIR AND FREON HOSE ASSEMBLIES . . . A wide selection of low pressure, synthetic hose assemblies with Pressed On Couplings, suitable for use with gasoline, oil, diesel fuel, air, water, grease, kerosene and common hydraulic fluids, is presented in Anchor Catalog No. 601. Also described are special tube-hose combination assemblies, such as are used for power steering, and a complete range of Freon 12 assemblies. A copy of this catalog may be had by writing to Anchor Coupling Co. Inc., 370 North Fourth St., Libertyville, Ill.

O-M
COMPACT IN DESIGN
KING SIZE
IN PERFORMANCE



O-M Tie-Rodless Cylinder
150 psi Air — up to 1500 psi Oil



Meets JIC Standards
Fits Where Others Won't

Here's the famous O-M Original Tie-Rodless Cylinder that takes one third less installation space than conventional tie-rod type yet packs plenty of power on both air or hydraulic circuits.

The result of modern research, design and engineering know-how, this powerful O-M component figures importantly in today's automation picture. Its high operating efficiency and ease of maintenance combine with its space-saving design and rugged construction to make it highly desirable in any application where its capacity meets specifications. Ports are easily oriented to any position.

O-M Air and Hydraulic Tie-Rodless Cylinders are available in a complete range of sizes (1 ½" to 8" bores) with standard or heavy duty rods. Completely interchangeable parts and mounts. Immediate delivery on many sizes.

Mail coupon now for Bulletins 101A (O-M Tie-Rodless Air and Hydraulic Cylinders) and 105 (O-M Series T-H Heavy duty Hydraulic Cylinders).

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☐ Send Bulletins 101A and 105

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Applied Hydraulics

THE MAGAZINE OF FLUID POWER

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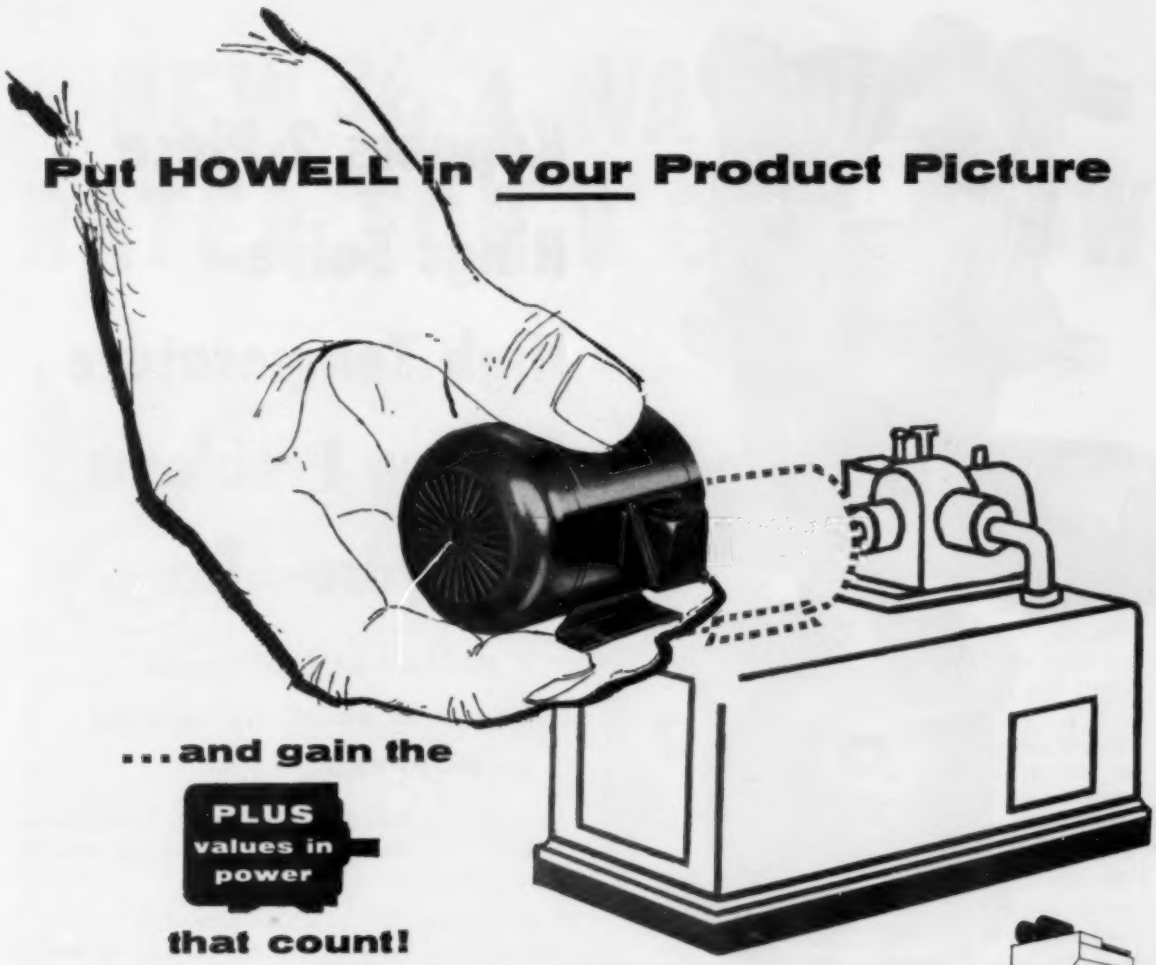


...and gain the

PLUS values in power

that count!

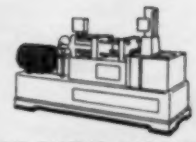
No matter how efficiently designed your hydraulic equipment may be, in operation its dependability rests . . . year in and year out . . . on the motors you select to power it. That's why manufacturers and users of hydraulic machinery, from simple pumps to the largest presses, are specifying Howell motors in ever increasing numbers. Here are a few of the reasons:

EXTRA DEPENDABILITY that challenges the years. Howell's new principle of heat-source ventilation . . . double sealed bearings . . . tough rolled steel frames and precision fitted cast iron end plates . . . these and many more are plus values that *count!*

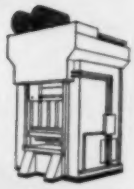
AN UNSURPASSED REPUTATION for engineering excellence and quality manufacture . . . built up by Howell in over 40 years of serving industry's motor requirements.

TOPS IN APPEARANCE. No other industrial motors have such smooth, unbroken contours . . . without an external fin or rib to mar their looks or catch dust deposits.

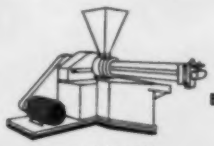
Howell makes virtually every type of AC industrial motors . . . fractional and integral to 300 hp, in all standard enclosures, in both rerated and non-rerated frame sizes, and in many pump mountings. Howell part winding motors, for economical reduced voltage starting of pumps may be of special interest to you.



DIE CASTING MACHINES

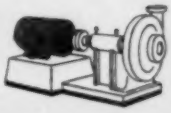


HYDRAULIC PRESSES



EXTRUDERS

HYDRAULIC ELEVATOR UNITS



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Howell motors are specified and used by these leading manufacturers of hydraulic equipment:

The Denison Engineering Co. • Hydraulic Press Manufacturing Co. • Rotary Lift Co. • Globe Hoist Co. • Century Hydraulics, Inc. Haughton Elevator Co. • Michigan Drill Head Co.

A Howell sales engineer can give you valuable assistance on any motor application. Wire or 'phone collect . . . or drop us a line . . . you'll get prompt action. Howell Electric Motors Co., Howell, Michigan.

HOWELL *motors*

...precision built for industry since 1915

Koppers 2-Piece Sealing Rings are installed on hot air shut-off valves manufactured for aircraft by Hydro-Aire, Inc. Ring inners are of stainless steel . . . ring outers are made of high chrome alloy heat resistant cast iron. Diameter is 1¼"

Koppers 2-Piece Rings Solve High Temperature Sealing Problems for Hydro-Aire

A Product of Continuous Research and Development by KOPPERS

To solve a sealing problem at high temperatures, Koppers engineers created a new sealing ring for Hydro-Aire, Inc.

Hydro-Aire, Inc. . . . a subsidiary of Crane Co. . . . manufactures hot air shut-off valves for aircraft applications. Ordinary rubber "O" rings couldn't withstand the high temperatures involved.

Koppers engineers designed a 2-Piece Sealing Ring with extremely close tolerances that provides maximum sealing at high temperatures. Primarily designed for aircraft applications, this new type ring can be used for sealing fuel oil and hydraulic oils as well as hot air and other gases.

The Hydro-Aire application is an interesting example of how highly trained Koppers engineers can solve customers' sealing problems. Koppers engineers in your area will be glad to study your applications and design the proper type of ring.

KOPPERS®

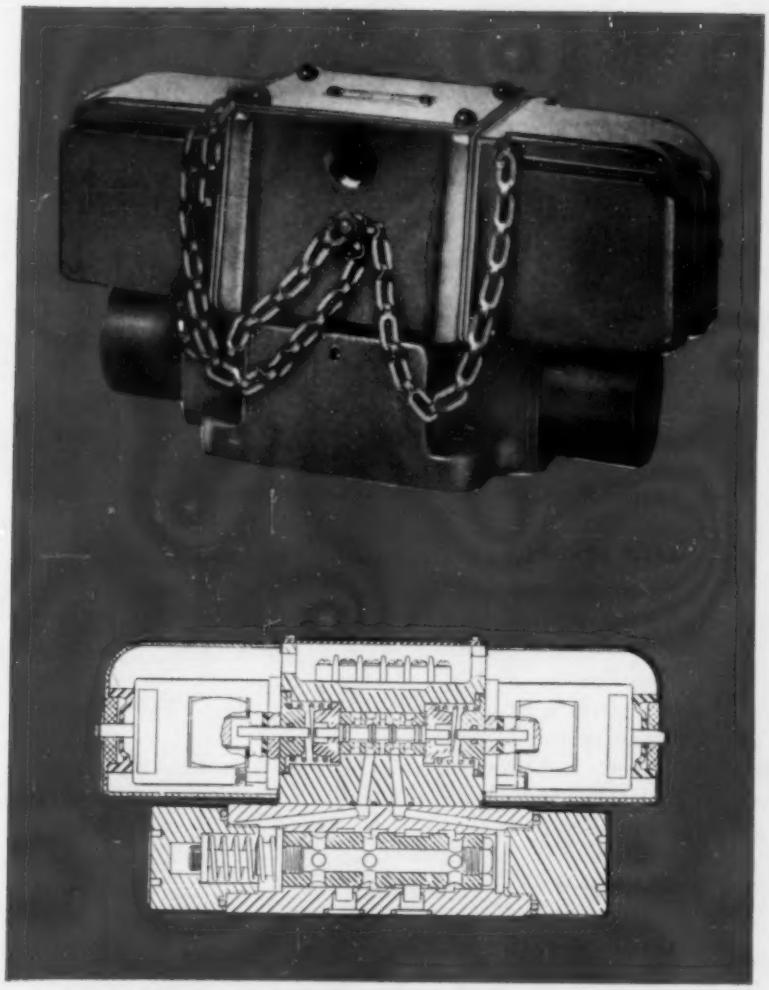
To lower your production costs, bring your ring problems to Koppers. Write to KOPPERS COMPANY, INC., 1510 Hamburg Street, Baltimore 3, Maryland.

RING-TYPE SEALS

Koppers Company, Inc., Metal Products Division
Piston Ring and Seal Department

Engineered* Products Sold with *Service

NEW 3/8" 4-WAY VALVE RATED FOR 8 GPM FLOW



- *requires less space*
- *requires less current*
- *lower cost than valves previously used*

Several inches shorter and still has more flow capacity than direct solenoid valves. It fills the void in solenoid operated valves between ¼" and ¾" I.P.S. . . . virtually eliminating the need for direct solenoid valves of ¼" and larger I.P.S.

The same size solenoids as those on ⅛" or ¾" valves are used in this model, thus same solenoids can be placed throughout circuit where different sized valves are needed. By using smaller solenoids than direct solenoid valves, lower current is required making possible savings in cost of electrical equipment.

Surges in tank line will not affect valve operation. Speed of spool traverse can be controlled for smoother shifting. Valve can be externally piloted if desired.

Drain line surges are eliminated by exclusive Double A solenoid seal drain. Double solenoid, no spring models come with detent.

priced from $60.00

COMPLETE LINE OF HYDRAULIC VALVES

Double A PRODUCTS CO.

MANCHESTER, MICHIGAN

Write for catalog and specification sheets.

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Fluid Power Lines

about Applied Hydraulics

FOR BUSY READERS . . . If you read everything that crosses your desk, chances are you'd never have time to do your job. You're a busy man. APPLIED HYDRAULICS is edited for busy readers. The emblem here and on our cover symbolizes the way we are giving you more value for your reading time.

Distilled Writing boils off every article's extra words. Result: you get the facts in shorter, clearer, brighter style. The articles are not digests; they're complete, just distilled.

This means that your reading time goes farther, pays you bigger dividends by reading APPLIED HYDRAULICS. It means, too, since each article is shorter, we will give you more articles in each issue.

More articles, more easily read articles; that's Distilled Writing. Let us know how you like it.

PRIZE PAPER CONTEST . . . At the opening session of the National Conference on Industrial Hydraulics in Chicago on October 17 and 18, APPLIED HYDRAULICS will present $1200 in awards for its annual Prize Paper Contest. It is through this contest that AH brings recognition to engineering developments in the fluid power field. Basic ideas explained in these papers will be valuable to engineers in all industries where fluid power is applied. To all entrants AH expresses thanks and compliments on the outstanding ideas which were evident in the designs and methods described in their papers. All prize winning papers and those receiving honorable mention will be published in APPLIED HYDRAULICS during the next year.

JACK BENDROR . . . One morning last month, AH's office phone rang and Jack Bendror announced he was in town from New York City to set up a book binding machine which he had described in his first-prize winning paper. We of course hurried out with him to learn more about this cleverly designed machine which spans 75 years of inactivity in that field.

Jack's had excellent training for this work with a BME and MME from New York University. He is presently assistant Chief Engineer of Printing Industries Equipment, Inc. where his activities range from design work to the supervision of manufacturing.

MAURICE BESHOURI . . . Machines for leveling railroad tracks or medical equipment which gives "shots" without a needle are all part of the day's work for an engineer working with a distributor of hydraulic components. Maurice Beshouri joined J. N. Fauver Co. in Detroit after graduating from Wayne State University in 1953 with a Bachelor's Degree in Mechanical Engineering. His responsibilities are to develop the best hydraulic circuit for the job and then see that it works. Maurice's designs frequently require speed control for machine tool slides, so he's well familiar with the feed panel units he discusses in his second-prize winning paper.

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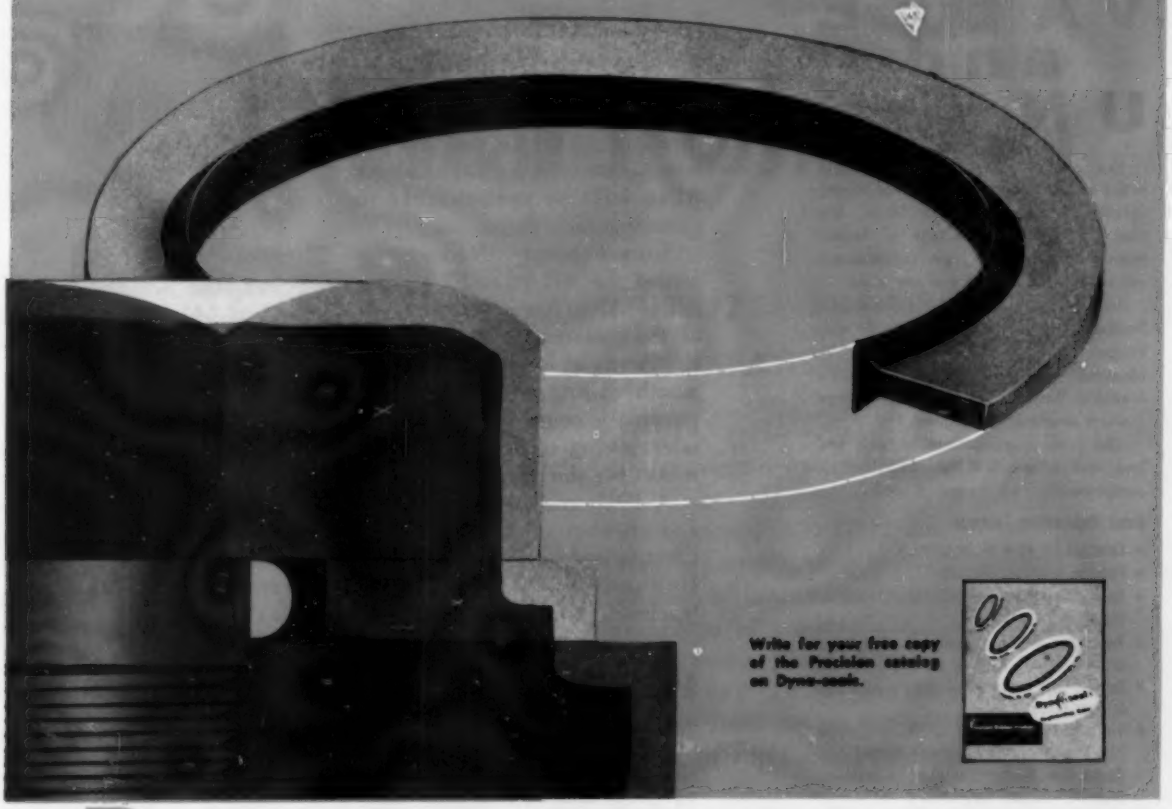
For face to face sealing

Easy-to-handle one piece seal of rubber bonded to a steel washer.

Available in-stock sizes for No. 5 screw to 1-⅛" bolt.

No special machining required.
Reduces assembly costs.
Positive sealing up to 10,000 P. S. I.
Vibration proof, lock washer action.
Reduces bolting torque.
Reusable - cuts maintenance.

Let a Precision engineer demonstrate the Dyna-seal cost and labor saving advantages to you.



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"O" Ring and Dyna-seal Specialists

Dept. 1, Oakridge Drive, Dayton 7, Ohio **Canadian plant at: Ste. Thérése de Blainville, Québec**

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Worcester's New Econ-O-"Miser" Ball Valve* is BOTH

VALVE and UNION

The costs of a union and installing it are eliminated. Add to this the longer operating life of the Econ-O-"Miser," the time and materials savings of *in-line maintenance*, and you get performance unmatched by *any* valve at *any* price.

The Econ-O-"Miser" is available in Bronze, Aluminum, Aluminum Bronze, Forged Carbon Steel, types 303 and 316 Stainless Steel. Seat and seal materials available. Teflon, Buna-N and Neoprene (others available on request.)

The many combinations of body and seat seal materials allow handling of exceptionally wide range of media.

Other Outstanding Features

- Compact for ease of installation
- Positive leakproof shut-off
- **In-line maintenance** permits quick, easy inexpensive repairs
- Two-way flow allows application of pressure or vacuum to either side of valve
- Quarter turn operation — readily adaptable to remote control
- Visual determination of OPEN — CLOSED positions — No manual check needed
- Round flow through the valve — minimum pressure loss and turbulence
- "Wiper-action" of resilient seat against ball eliminates abrasive wear due to foreign materials in media . . . assures leak-proof seal . . . long operating life

* Pat. Pending

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Fluid Power / Lines

continued

CONRAD R. HIMMLER . . . The Centre de Recherches Hydrauliques et Electriques where Conrad Himmler developed the servo designs he describes in his third-prize winning paper is a private development institute created by a French industrial group. He joined the organization in 1945 as technical director after extensive experience with German aircraft hydraulic systems. A Doctor of Engineering, Himmler's recent work has been in the design of high-pressure, variable-delivery pumps, servo valves, torque amplifiers for power steering, and radial and axial piston motors. He is the author of the hydraulic text book, *La Commande Hydraulique*, as well as other publications on hydraulics.

NAMED EXECUTIVE EDITOR . . . Starting with this issue, Allan Morris assumes the responsibilities of executive editor. Under the direction of AH's editor and publishing director, Paul Rolnick, Allan will be responsible for planning each issue.

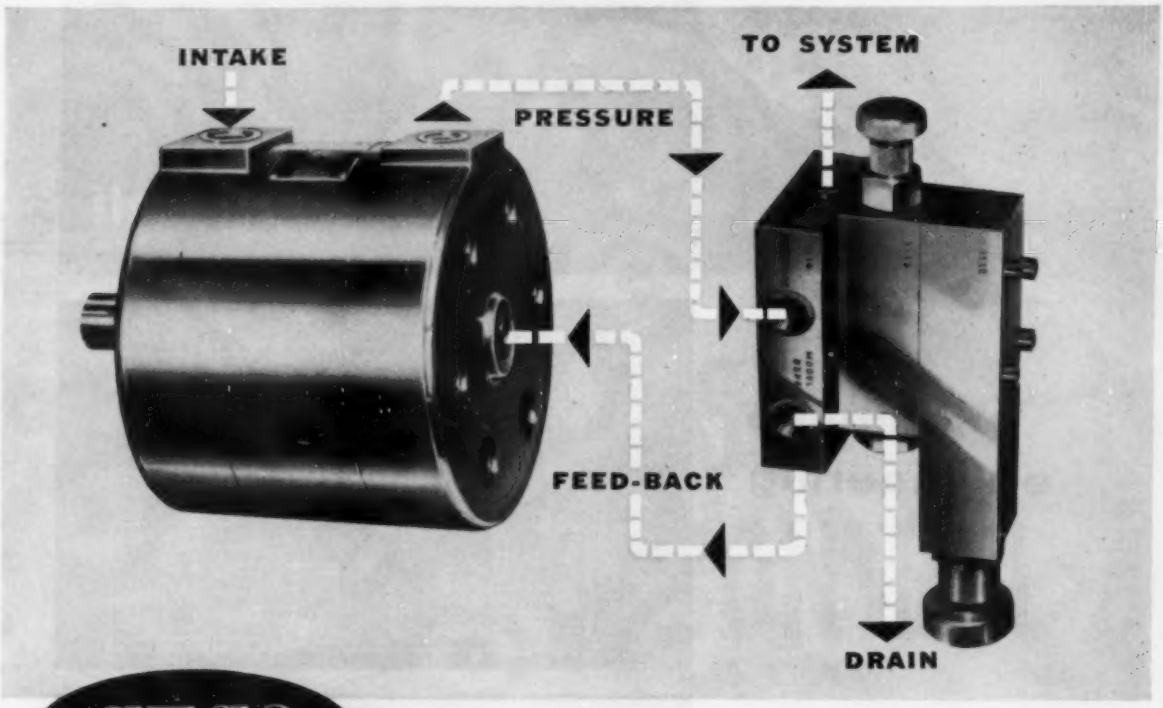
ALLAN MORRIS

Since February 1955 when he joined the AH staff as associate editor, Allan has developed many of the technical articles in AH. He travels at least one week each month calling on designers and users of hydraulic and pneumatic components. For the past three months he's been interviewing builders of mobile equipment to prepare a report for the coming December issue.

A 1948 graduate electrical engineer from Illinois Tech and member of Tau Beta Pi, Allan worked for General Electric and Goodyear Aircraft before joining the AH staff. He's active in AIEE, Cleveland Engineering Society, and teaches industrial hydraulics to evening classes.

KNOW YOUR FLUIDS . . . New fire resistant fluids are appearing on the market rapidly, and constant improvements are being made. To keep you informed on the FRF'S this month's fifth article in the series discusses preparation of equipment for change-over.

HAPPY LANDINGS . . . and takeoffs for the Ryan X-13 Vertijet depend upon proper functioning of a good deal of hydraulic equipment used on the special Fruehauf trailer which serves as its airfield. For a complete description of what it is and what it does, see the article on page 133.



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VARIABLE DISPLACEMENT

radial piston pump

UTILIZES THE NEW "*PULSE GENERATION*" TECHNIQUE

Displacement of this radial piston pump is varied by a unique pressure feed-back (patented) principle. The control valve governing feed-back may be remotely located. Due to inherent simplicity of design, this pump and its control valve provide a *low cost* variable displacement system that equals or *surpasses* the performance of more costly conventional variable displacement machines. As compared to *fixed* displacement pumps and controls, horsepower savings are high – as much as 85%.

The standard SECO D5PF control valve permits adjustment to a constant pressure regardless of flow demands, or a constant flow regardless of pressure — within the capacity of the pump. The D-5 pump illustrated delivers 0 to 5 G.P.M., and the pressure is adjustable from 200 to 2,000 PSI. For a wide variety of applications this pump is ideal.

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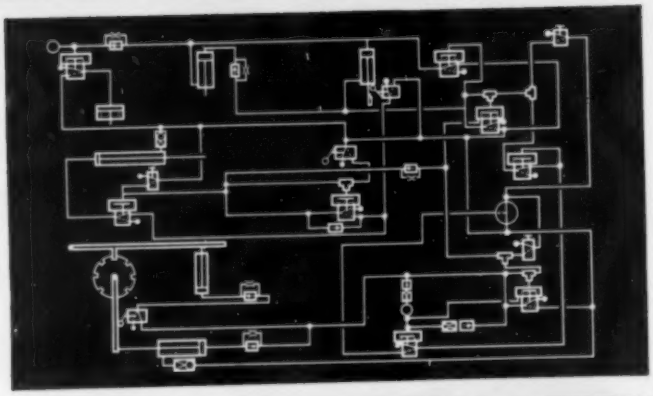
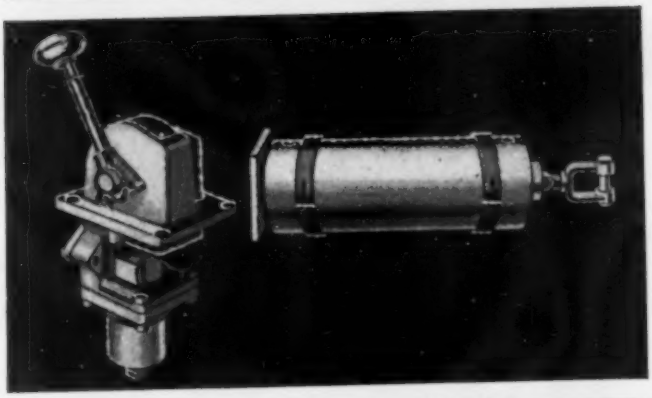
pneumatic engineering



pneumatic control equipment



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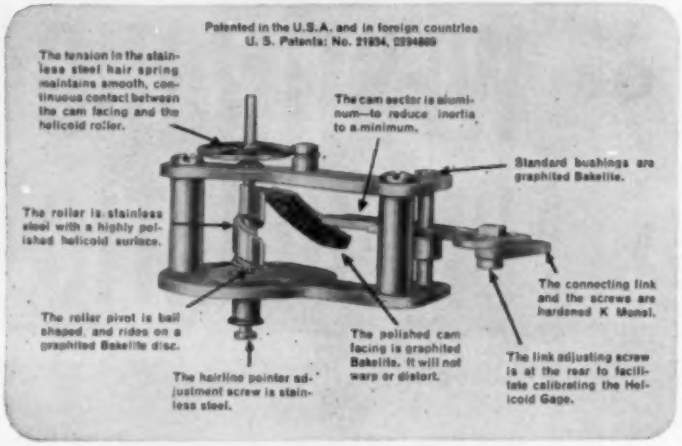
These details of Helicoid gage design assure longer life and enduring accuracy

The superiority of Helicoid Gages is most evident in severe service—wherever a gage is subjected to violent pressure pulsations or severe mechanical vibrations.

The *sustained accuracy* of Helicoid Gages over *millions of cycles* is explained by the details of design and construction of the Helicoid movement shown at the right.

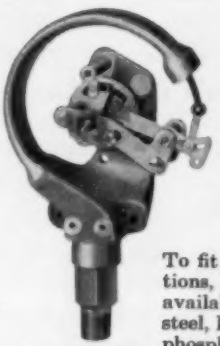
Rolling action of the cam facing against the roller surface . . . graphited Bakelite bushings, roller pivot base and cam facing . . . K Monel connecting links and screws . . . all such Helicoid features protect against wear and corrosion and assure sensitivity, sustained accuracy and trouble-free operation through millions of cycles.


Patented in the U.S.A. and in foreign countries
U. S. Patents: No. 21934, 2294805
The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is aluminum—to reduce inertia to a minimum.
Standard bushings are graphited Bakelite.
The roller is stainless steel with a highly polished helicoid surface.
The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

EASIEST ADJUSTMENT AND CALIBRATION

Only Helicoid Gages have the external pointer adjustment pictured here. The Helicoid type adjustment cannot be jarred out of position.

Calibration of Helicoid Gages is accomplished easily, without removing dial or pointer, because the link adjusting screw is at the rear of the system.



TUBES BUILT FOR MILLIONS OF PRESSURE PULSATIONS

To fit the wide range of applications, Helicoid Bourdon tubes are available in four materials—alloy steel, K Monel, stainless steel and phosphor bronze.

All Helicoid tubes are made from seamless tubing and are carefully designed to give maximum torque and minimum stress. When used within the dial range, they will withstand many millions of pressure pulsations and will not stretch, leak or crack.

HELICOID DIALS ARE EASIEST TO READ

Helicoid Gage Standard Dials are well known for quick and easy readability. Tests show that they are easily read at a greater distance than is ordinarily possible.

Dials are furnished jet black with white figure markings or dull white with black figure markings. Standard dials are of laminated phenol with a transparent plastic surface. They are non-corroding, will not discolor, fade, crack, chip or peel and can be cleaned without damage.

For complete information on the Helicoid line of gages write for **Catalog G-52**

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Helicoid gives you all these features at prices that are competitive in the quality gage field

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WITH INDUSTRIAL MOUNTINGS

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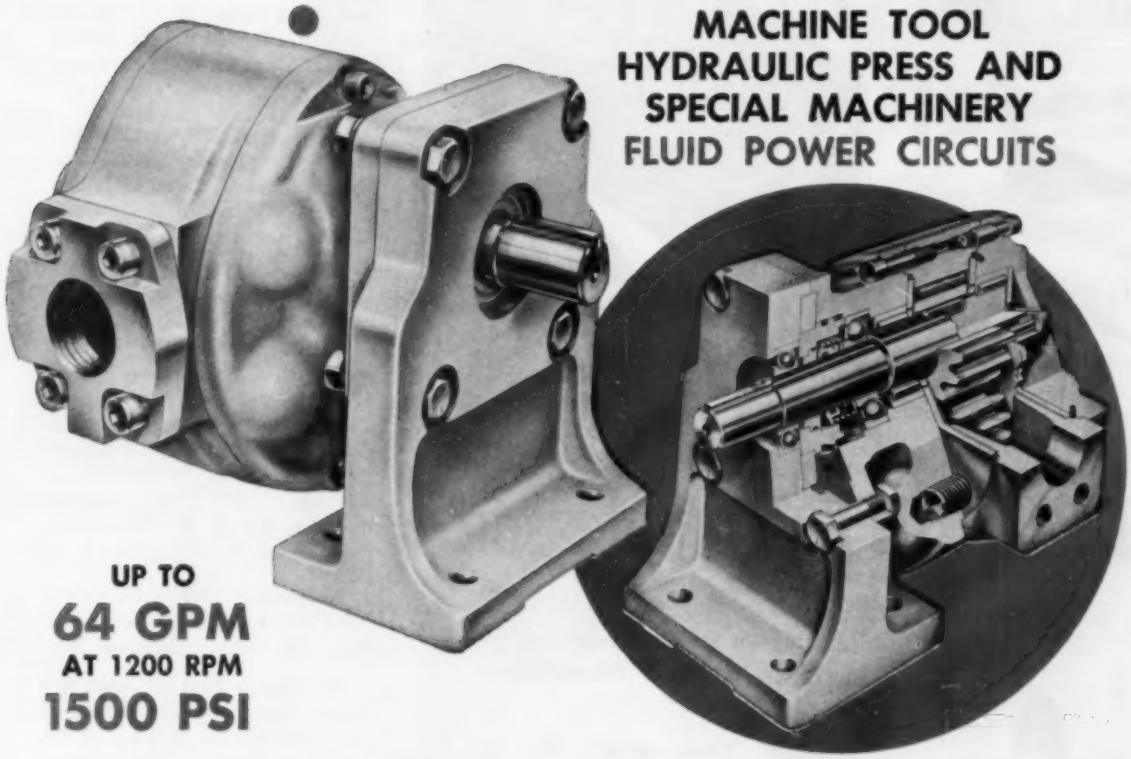

UP TO
64 GPM
AT 1200 RPM
1500 PSI

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Make this simple test! If your hydraulic cycle is comparable to that of a tractor-shovel digging a foundation . . . a front-end loader working a gravel pit . . . or, a mammoth bulldozer crowding a bank . . . and working at full relief pressures nearly all the time—then YOU can use HYDRECO Gear Pumps to advantage! HYDRECO Gear Pumps can save YOU money NOW—in both original equipment and replacement costs.

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Belmont "Compressor" No. 760 withstands such gruelling service—and protects compressor rods from premature wear.

This asbestos packing is lubricated strand by strand, braid by braid, layer by layer—to retain its flexibility and good sealing qualities.

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are ready to serve you promptly and helpfully, wherever you are.

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Future Events

October 17-18: The 13th Annual Conference on Industrial Hydraulics. Hotel Sherman, Chicago, Illinois. Raymond D. Meade is Conference Secretary.

October 23-25: Fall meeting National Fluid Power Association, Washington, D. C. For details write: Barrett Rogers, NFPA, 1618 Orrington Ave., Evanston, Illinois.

October 24-25: Aircraft Electrical Society, 14th Annual Display of Aircraft Electrical Equipment. Pan Pacific Auditorium, Los Angeles, Calif.

October 31-November 2: National Conference "Engineering and Scientific Education—Foundation of National Strength", sponsored by the Western Society of Engineers, Engineers Joint Council, the Scientific Manpower Commission, the National Science Foundation and the National Academy of Sciences—National Research Council. Edgewater Beach Hotel, Chicago, Illinois.

November 4-6: Ninth Annual AIEE Machine Tool Conference, Hotel Schroeder, Milwaukee, Wis.

November 13-15: Eighth National Conference on Standards and 39th Annual Meeting of the American Standards Association. St. Francis Hotel, San Francisco, California.

January 13-17, 1958: SAE Annual Meeting and Engineering Display, The Sheraton-Cadillac and Statler Hotels, Detroit, Michigan.

March 31-April 2: SAE Production Meeting and Forum, The Drake, Chicago, Illinois.

April 8-11: SAE Aeronautic Meeting, Aeronautic Production Forum, and Aircraft Engineering Display. Hotel Commodore, New York, N.Y.

May 1-8: ASTE Tool Show, Convention Center, Philadelphia, Pa. For complete information write ASTE, 10700 Puritan Ave., Detroit 38, Mich. ▼▼▼

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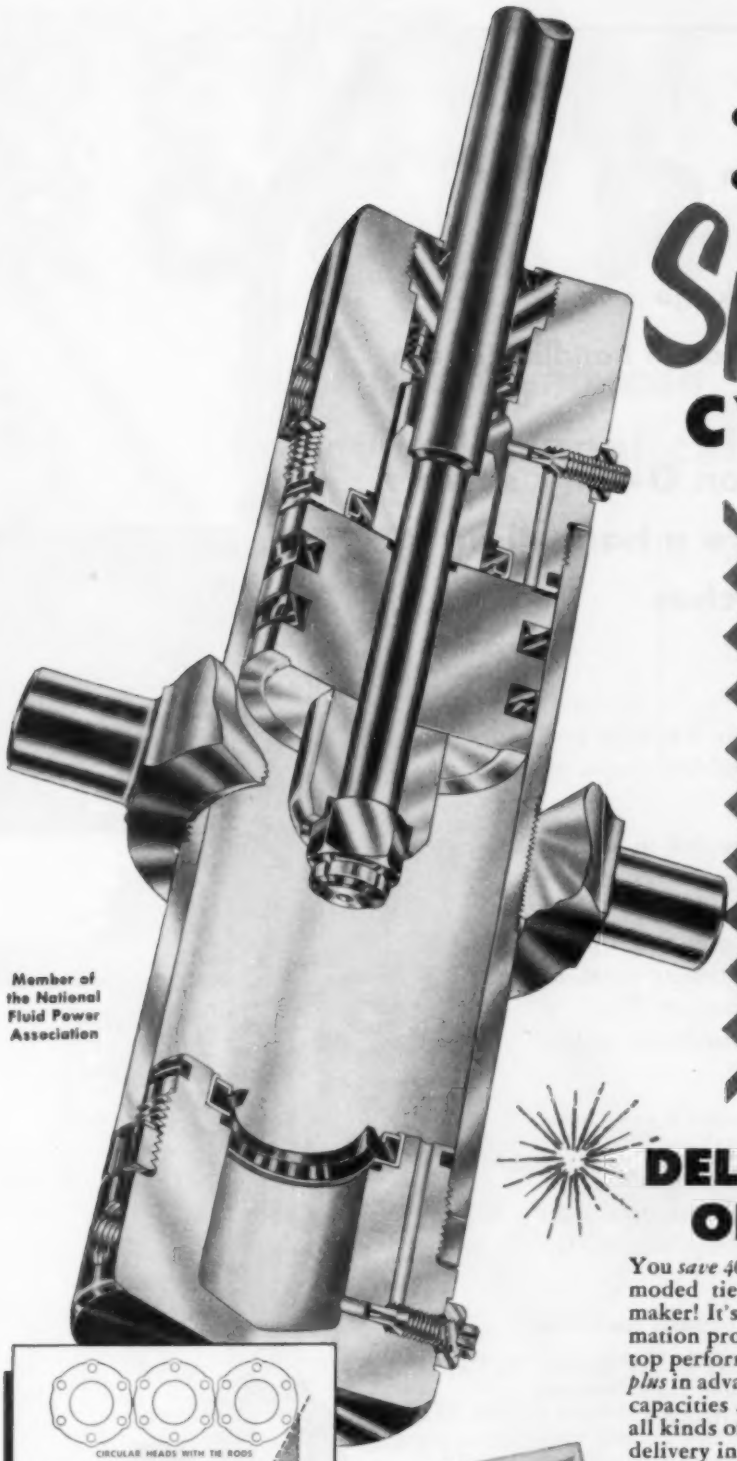

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- **STRONGER** than outmoded tie rod design, proven through actual tests. No tie rods to stretch.
- **SOLID STEEL HEADS** throughout the full line.
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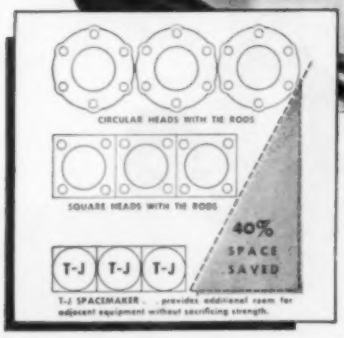
CIRCULAR HEADS WITH TIE RODS
SQUARE HEADS WITH TIE RODS
40% SPACE SAVED
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T-J SPACEMAKER . . . provides additional room for adjacent equipment without sacrificing strength.

DELIVERY OFF THE SHELF!

You *save 40% space* when you switch from outmoded tie rod cylinders to the T-J Spacemaker! It's stronger, too! Fits right into automation programs in countless plants. Delivers top performance and dependability with a big *plus* in advanced features. Wide range of styles, capacities . . . reduces man-hours and costs in all kinds of push-pull-lift operations. Off-shelf delivery in 64,000 combinations!

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Ozone deterioration

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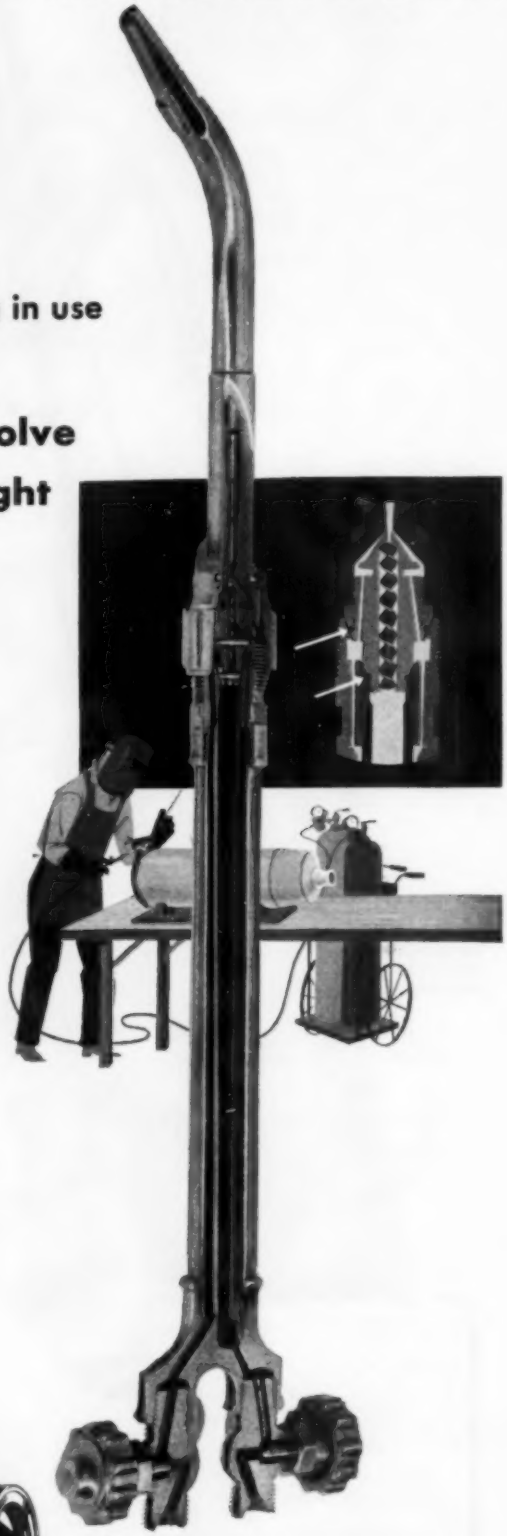
Rough handling in use

New National Hypalon O-rings solve these problems; insure a hand-tight gas seal in Victor Torches



As static seals, commercial Buna N O-rings performed satisfactorily in Victor welding torches — *when the rings were new.*

However, ordinary O-rings age fast in welding torches. They receive rough treatment when welders change nozzles; nozzles are often dropped on the ground to lie there until needed again. Severe ozone deterioration is experienced. Continuing stress, although mild, impairs O-ring elasticity. Rings on welding nozzles are sometimes subjected to long shelf life.

National Seal engineers developed a new O-ring compound, National Hypalon L-11, which not only withstands rough handling, ozone deterioration and stress but exhibits many times the shelf life of Buna N compounds previously used. Today, National Hypalon is standard at Victor.

Special compounding to meet unusual conditions is a basic part of National's complete O-ring engineering service — service available from National Field Engineers in major cities nationwide.

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the tubing you can use *"as supplied"* for cylinder applications

inside diameter needs no further processing –

inside working parts may be standardized –

When the design calls for cylinders, count on big savings with ROCKRITE tubing. Sized cold, by *compression*, ROCKRITE provides a polished-smooth, scratch-free surface and extremely close dimensional tolerances. No boring or honing is required. Parts production can be standardized from ROCKRITE tubing cut-to-length and used "as furnished."

For your next application that requires close tolerance I.D. tubing, *remember to reduce cost* with ROCKRITE.

***NEW TECHNICAL BULLETIN*–Write for it today!**

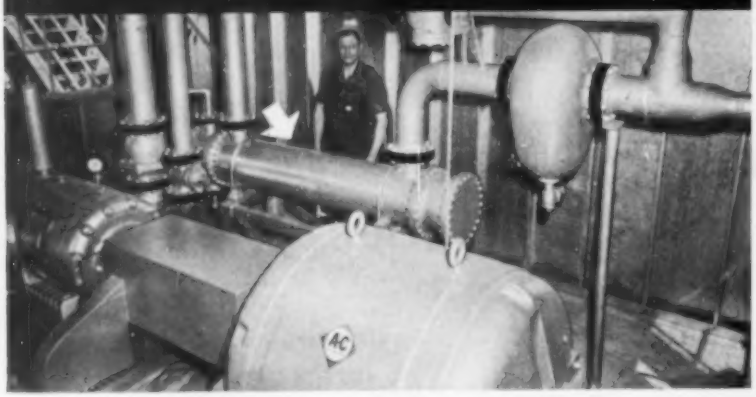
Describes how the ROCKRITE process imparts cylinder-finish to tubing. Application facts and performance data for your reference. Write for your copy of this Bulletin R7A today.

ROCKRITE® TUBING

TUBE REDUCING CORPORATION

WALLINGTON, NEW JERSEY

Young cools the gas at this Northern Wisconsin power plant



Superior design and construction make this Young Heat Exchanger first choice for this vital operation

Cooling 1296 C.F.M. of gas from 325°F to 100°F makes exacting demands on equipment. Design and construction features must insure long hours of perfect, unbroken operation, providing maximum cooling with minimum drop in pressure.

On the "Ro-Flo" compressor, a product of Allis-Chalmers, shown in the illustration above, a YOUNG Type "R" Shell and Tube 2-pass Heat Exchanger does the job—and does it well. Tubing is of Admiralty Brass to insure longer life; units of copper, aluminum, stainless steel, etc., are available for special requirements. The special floating head design eliminates expansion strains resulting from fluid temperature differences.

Pre-eminent in the field of heat transfer, years of experience enable Young Radiator Company to reduce "difficult" problems to matters of standard procedure. The accumulated knowledge and experience of our engineers is at your disposal. Consult with our representatives in all principal cities or direct with the home office. There is no obligation.

Write today to Dept. 447-K for catalog 1156

Young RADIATOR COMPANY
RACINE, WISCONSIN
Creative HEAT TRANSFER ENGINEERS
Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Mattoon, Illinois

LETTERS to the editor

Address your letters to: Editor, APPLIED HYDRAULICS Magazine, 812 Huron Rd., Cleveland 15, Ohio.

Metal Reed Seals

In your Letters to the Editor in your July issue, we noted a request for information on metal reed type seals. We are also interested in new seal designs, and would appreciate information on this type.

R. L. STVERAK
Sales Engineer
Koppers Co., Inc.
Baltimore, Md.

We have forwarded your letter to George Keller of North American Aviation, who refers to this type of seal in his book "Aircraft Hydraulic Design". He will probably be able to give you several sources.

Temperature Control

We read your article "Temperature Control in Hydraulic Systems", appearing in your August issue, with great interest. Our information agrees approximately with your curve Fig. 7, but we would like further explanation of the significance of Table IV. Also, your curve, Fig. 7, did not tally with Table IV.

R. AFFOUARD
Meudon, France

We have received a letter from Hans W. Hamm, who originally prepared the material from which Table IV was taken, and believe the answers to your questions are covered in his letter as follows:

I was delighted to obtain your report on "Temperature Control in Hydraulic Systems". It will be very useful to me, and undoubtedly to many other people, as it will save us many hours of work to have so much information condensed and readily available. In my contribution to this report, there is a typographical error.

Continued on page 24

Eastman

First to be specified by America's leading OEM's

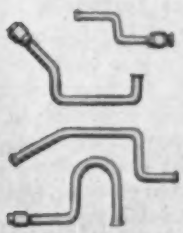
It's a known fact that many leading Original Equipment Manufacturers submit their original specifications for their *first* quotation to Eastman.

EASTMAN's unequalled experience in hydraulic conversion, plus many original designs shown in a few popular Eastman fittings at the right—give your product an appearance of quality that improves its competitive position in your field. It's a mark of distinction to be Eastman equipped!

EASTMAN Engineering Service . . . Backed by Unequalled Experience

It is also a known fact that Eastman's co-operative engineering counsel and service is highly respected and often requested by leading OEM's. Let Eastman engineers help you lay out your fluid power lines—from pump to point of work—effecting economies in design, improving performance and increasing user satisfaction.

Let EASTMAN recommend the *best assembly . . . for the best performance . . . at the lowest cost.*



Bent Tubing with the necessary fittings to meet your own specific requirements.

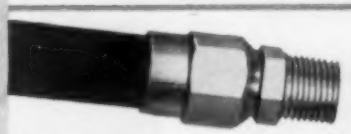
Adapters, Adapter Unions and Boss "O" Ring Fittings. All types and sizes available.

A COMPLETE LINE OF HYDRAULIC FITTINGS and HOSE ASSEMBLIES . . .

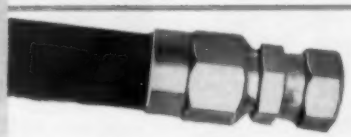
Permanently Attached Male (NPTF) for 1, 2 and 3 wire braid rubber cover hose, and 4 spiral wire extra high pressure hose.
Sizes: 3/16" thru 3".
Wkg. pressure: 375—5000 p.s.i.

Permanently Attached Male Flare (JIC) for 1, 2 and 3 wire braid rubber cover hose.
Sizes: 3/16" thru 2".
Wkg. pressure: 375—5000 p.s.i.

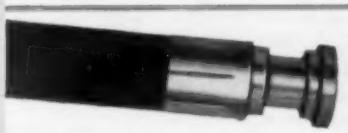
Permanently Attached Swivel Female for 1, 2 and 3 wire braid rubber cover hose.
Sizes: 3/16" thru 2".
Wkg. pressure: 375—5000 p.s.i.



Reusable Male (NPTF) for rubber and cotton cover hose.
Sizes: 3/16" thru 1 13/16".
Wkg. pressure: 375—5000 p.s.i.



Reusable Swivel Female for rubber and cotton cover hose.
Sizes: 3/16" thru 1 13/16".
Wkg. pressure: 375—5000 p.s.i.



Permanently Attached Flanged Head Couplings for 1 and 2 wire braid rubber cover hose.
Sizes: 1/4" thru 2".
Wkg. pressure: 375—5000 p.s.i.

Clamp Type Coupling with split flange stems for 1 and 2 wire braid rubber cover hose.
Sizes: 1/4" thru 2".
Wkg. pressure: 375—5000 p.s.i.

Power Steering Assemblies to meet all your requirements.

Eastman *first in the field*

MANUFACTURING COMPANY
Dept. AH-10
MANITOWOC, WISCONSIN

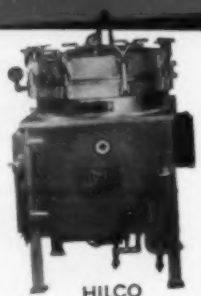
ENGINEERS:
Write for Technical Bulletin 200 for Complete Information and Data on Fluid Power Lines.

Keep YOUR HYDRAULIC SYSTEM Clean with HILCO HYDRAULIC OIL FILTER

- No More Varnish and Sludge Deposits
- No More Flushing and Manual Cleaning
- No More Frequent Oil Changes
- No More Accumulation of Dirt

Filter life up to a year eliminates usual frequent draining, refilling of systems.

HILCO Hyflow Oil Filters trap dirt, acids, rust, sludge, gums, resins . . . all solid contaminants, and keeps your hydraulic system clean and in top running condition at all times. To you, this means longer oil life, reduced wear and abrasion . . . hence, less down time and lower maintenance costs giving you continuous equipment operation with increased production. Hydraulic unit sensitivity depends upon a clean system. HILCO Hyflow filters remove solids as soon as they enter the system and retain much of the moisture which enters the oil from the atmosphere and from condensation. Obtain the full capacity and economy of your equipment by keeping it in top running condition with HILCO. Hydraulic Oil Filters come in stationary or portable models. They can be hooked into hydraulic systems without interrupting equipment operation.



HILCO
OIL RECLAIMER
For complete oil reclaiming. Removes solids, acids and volatile impurities; moisture, solvents, gasses, etc., from hydraulic fluids by heat-vacuum process.

• SEE FOR YOURSELF HOW HILCO keeps your Hydraulic System Clean . .

WRITE TODAY FOR THIS *Free* BOOKLET

Recommendations at no Obligation

THE HILLIARD *Corporation*

148 W. FOURTH ST. • ELMIRA, NEW YORK

IN CANADA:

LETTERS to the editor

Table IV on page TC/7 gives heat transfer coefficients. Actually they are thermal conductivity factors for air, with the dimension Btu/ hr/sq ft/ deg F/ft, but for practical purposes in this connection, heat transfer coefficients are close enough. One of these should be .0183 for 212 F, instead of .183.

HANS W. HAMM
York, Pa.

Photocopies

May we have permission to make photocopies from our subscription issues of APPLIED HYDRAULICS? We can then circulate these copies to company employees and avoid the inconvenience of shipping our reference set.

(Mrs.) AGNES REINERO
Librarian
Pacific Gas & Electric Co.
San Francisco, Calif.

Permission granted.

Long Stroke Cylinders

We would like to know a source for hydraulic cylinders, ten feet or more in length.

HANS GUTHMANN
A & X Steel Products Co.
Baltimore, Md.

Many manufacturers can produce cylinders with a stroke greater than ten feet. A list has been sent.

Hydraulics Textbooks

I am to instruct a course in basic hydraulics at a local trade school this fall. We have several reference manuals at present, but none is elementary enough to use as a text. Could you recommend an elementary text covering basic hydraulics? It would prove helpful if you could provide us with the names of companies which might loan, rent, or allow us to use cut-away or display models of pumps, motors, valves, etc.

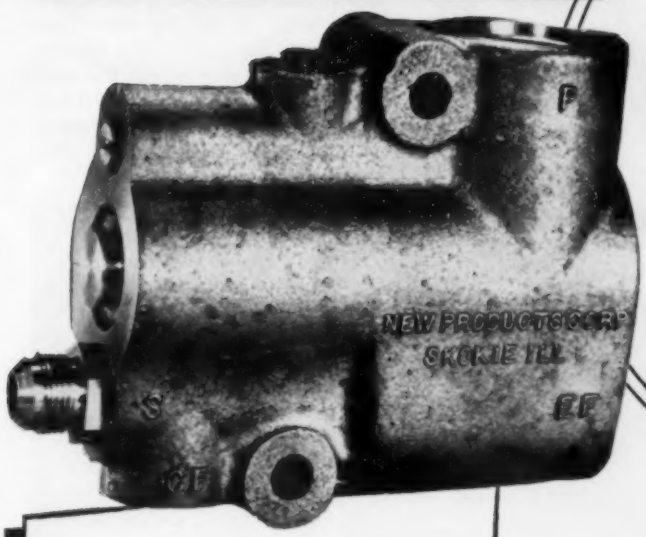
PAUL W. COOK, SR.
Continental Can Co., Inc.
Coffeyville, Kansas

The simplest book on hydraulics that we know of is the "Basic Hydraulics" booklet available from

Continued on page 26

NEW PRODUCTS FLOW DIVIDER

THE ANSWER to the problem of DIVIDING HYDRAULIC FORCE



ADVANTAGES

- Simple, easy to install and service.
- Permits two simultaneous operations from one pump.
- Divides the flow in any desired proportion.
- Adjustable to decrease flow at controlled flow side when excess flow side is worked.
- Operates on low circulation pressure.
- Handles any fluid at any temperature.
- Built-in relief valve.
- Quiet, compact.

WHAT IT IS!

The New Products Flow Divider is a simple valve mechanism. Main working parts are of the highest quality. Parts of steel where required are hardened, ground and honed and precision fitted for maximum efficiency and long life.

WHAT IT DOES!

The New Products Flow Divider makes the division of hydraulic flow to deliver proper force to two operations such as steering and lifting simultaneously a simple matter, just as does any other flow divider. An exclusive advantage that makes the New Products Flow Divider different is the adjustable restrictor on the controlled flow side. This feature provides an adjustment that can be set to cut the flow from 10% to 95% on the controlled flow side. When set to the required reduction, this takes place automatically as soon as the excess flow side is pressurized. Thus you never sacrifice performance of the main operation because of secondary operation. The restrictor also assures full efficiency with a smaller, less expensive pump than would otherwise have to be used. The New Products Flow Divider can be furnished with this feature or without it. Two other advantages include an adjustable orifice to vary the controlled flow and a built-in relief valve that bypasses oil back to the sump when the peak pressure setting of the controlled flow is reached. This setting is lower than the main circuit setting.

New Products Flow Dividers are built in two sizes:	
Model 1085	**25 gal. per min.**
Model 1088	**80 gal. per min.**

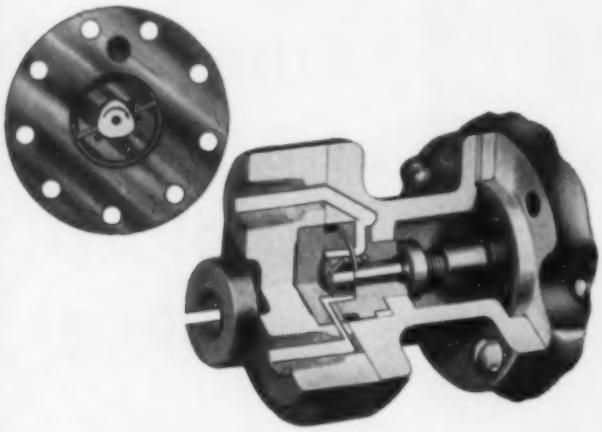
NEW PRODUCTS CORPORATION

3636 Oakton Street, Skokie, Illinois • Phone: ORchard 3-5873

WELDON

FLUID METERING PUMPS

Positive Displacement Rotor Type. For Industrial Applications, Aircraft Anti-Icing and Aircraft Fuel.



IT'S SO SIMPLE!

The rotation of the rotor draws the fluid in through two passages, filling the cavities formed by the three lobes of the rotor. This fluid is sealed within these small cavities until it is forced through the two outlet holes by the floating blades. The flow may be kept uniformly divided through two outlet ports, or may be combined internally for passage through a single port.

Compact • Light Weight

Send for Weldon Manual and Catalog with detailed specifications and installation drawings, covering the full range of Weldon pumps in various capacities. Specify your requirements.

THE WELDON TOOL COMPANY

3000 WOODHILL ROAD · · · CLEVELAND 4, OHIO

LETTERS to the editor

the Superintendent of Documents, Washington, D. C. To get some help obtaining models, we suggest you write to the National Fluid Power Association, 1618 Orrington Ave., Evanston, Ill. We have sent you the Jan. 1956 Fluid Power Index Issue of AH which includes a bibliography that should be of assistance.

Air Pump

We require a compact, lightweight air pump to circulate air in small volumes, such as 1 to 5 cfm at 10 psig, with no oil, carbon, or atmospheric air contamination. Air discharged from the pump is to go through a closed, leak-proof system for eventual analysis before going back to the intake of the pump.

L. A. FARRINGTON
Engineer
American Conditioning House, Inc.
Boston, Mass.

We have sent names of manufacturers who may be able to meet your special requirements.

Visual Aids

Have you available slides, films and other visual aids pertaining to applied hydraulics? We are preparing a program relating to hydraulic control systems for presentation to high school students, to stimulate their interest in an engineering or scientific education.

ARTHUR M. KRILL
Head, Mechanics Div.
University of Denver
Denver, Colo.

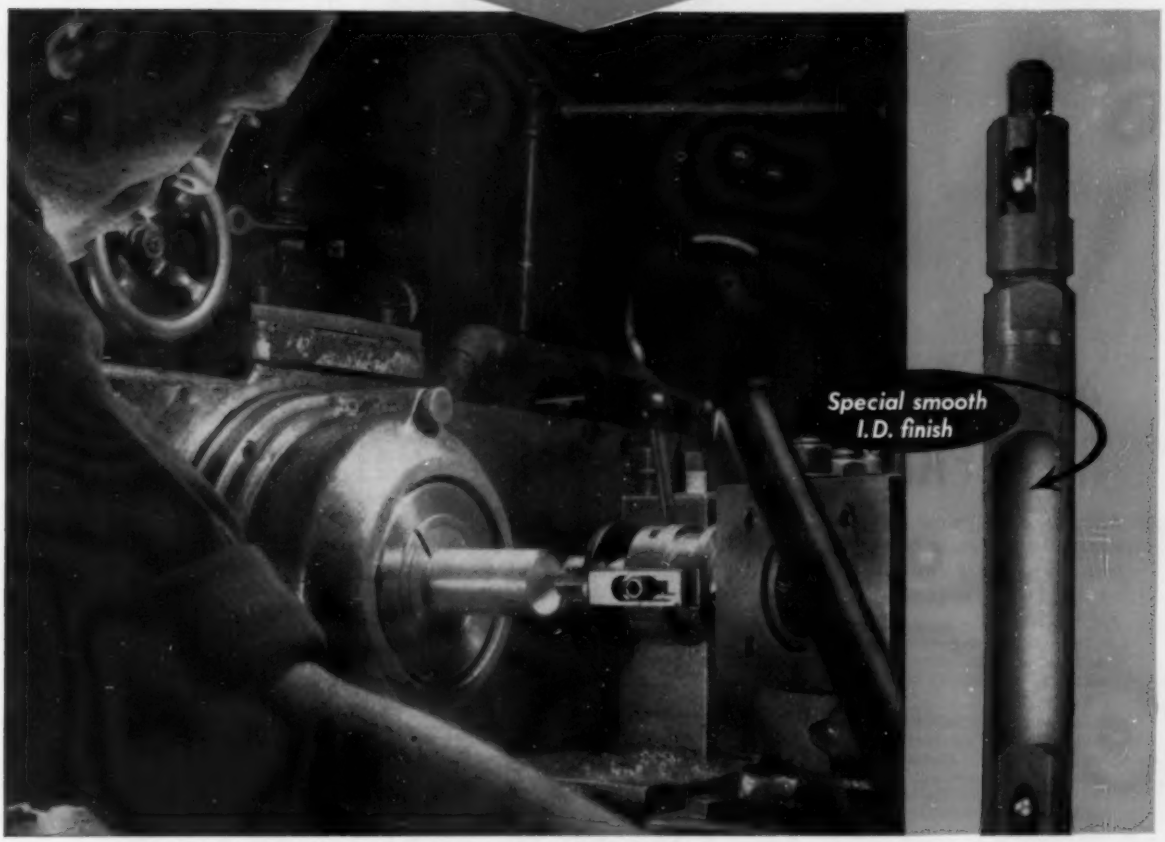
We have available only material and photographs from our magazine. However, there are some films available from various companies and government agencies. List has been sent.

Beginner's Course

A series of articles entitled "Beginner's Course In Hydraulics" appeared in your magazine in the past. This series was saved by one of our maintenance engineers, who has a personal interest

Continued on page 28

This pump manufacturer reports 25% savings with J&L COLD DRAWN ELECTRICWELD TUBING



Operator is threading 1¾" O.D. x 1½" I.D. J&L special smooth *cold drawn* Electricweld tubing for pump cylinder.

Low original cost and elimination of interior honing are two reasons why it pays you to specify J&L *cold drawn* Electricweld tubing with special smooth I.D. finish.

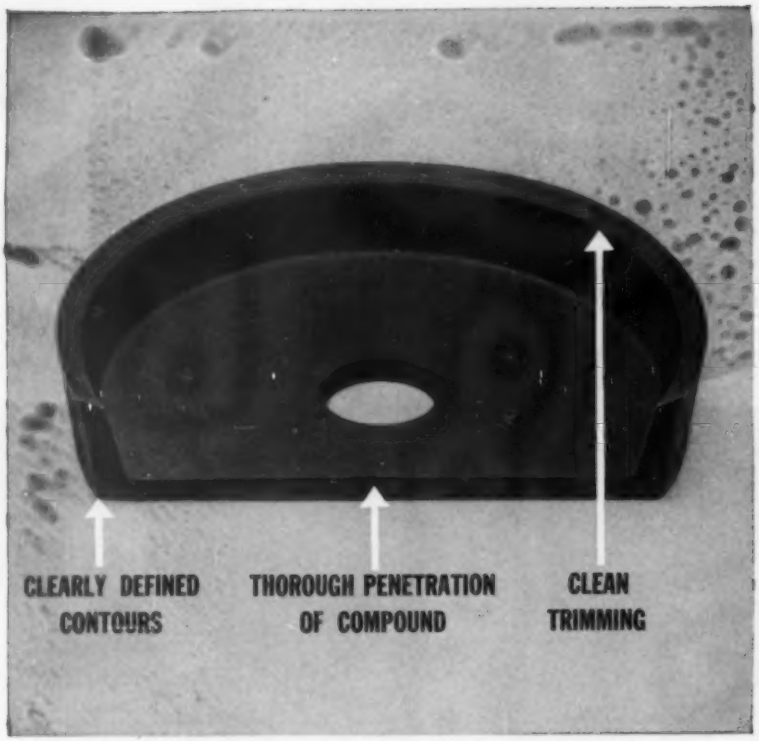
This manufacturer of oil well insert pumps reports a saving of 25% by converting from honed seamless tubing to *cold drawn* special smooth I.D. Electricweld tubing. Not a single tube failure has been reported from the field.

Because of its superior inside surface finish, exact tolerances and closely controlled physical characteristics, J&L *cold drawn* Electricweld tubing is recommended for these applications:

- *cylinder tubing* • *shock absorbers*
- *ordnance parts* • *hydraulic and pressure tubing*

J&L *cold drawn* Electricweld tubing is readily available in diameters from ¾" O.D. to 4¼" O.D., 8 gage to 20 gage, and can be furnished to closer than commercial tolerances. Write to Jones & Laughlin, 3 Gateway Center, Pittsburgh 30, Pa.

Jones & Laughlin
STEEL ... a great name in steel



A CLEAR CASE OF QUALITY...
R/M FABRIC PISTON CUPS

Designers of hydraulic and pneumatic equipment like these quality features built into R/M Fabric Piston Cups, because they mean extra performance and longer wear:

1. Precision molding—Note the clear definition of contours, smooth surfaces, clean trimming—all evidence of top-flight molding practice.

2. Superior impregnation—Cut an R/M Fabric Piston Cup apart, and you will see how R/M's special method gives deeper, more thorough penetration of the compound into the fabric. This keeps wicking action from destroying the cup internally and gives greater resistance to ply delamination.

3. Controlled tolerances—Careful quality control insures dimensional uniformity, consistent hardness, and strict adherence to industry standard sizes.

R/M Fabric Piston Cups are available to fit cylinders from ½ to 12 in. in diameter. Types are furnished in varying degrees of hardness for pressures up to 1500 psi and in different compounds to meet specific operating conditions.

R/M's complete line of mechanical packings includes: Vee-Flex Packings, Vee-Square Packings, Homogenous Vee-Rings, Fabric Piston Cups

For complete information, write for this booklet

R M **PACKINGS**
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

FACTORIES: Passaic, N.J.; Bridgeport, Conn.; Manheim, Pa.; Neenah, Wis.; No. Charleston, S.C.; Crawfordsville, Ind.; Peterborough, Ontario, Canada
RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Laundry Pads and Covers • Industrial Rubber • Engineered Plastics • Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Bowling Balls

LETTERS to the editor

in future developments of this type of training. The information in this series appears to us very valuable as a training aid for apprentices. Is this available in text book form? Have you developed any more up-to-date material for instruction in this field? We would like your recommendations on texts, visual aids, and films for our Technical School, being developed for an enrollment of about 200 apprentices in the Lynn area.

C. L. JOHNSON
Specialist
Apprentice Education
General Electric Co.
West Lynn, Mass.

It has been five or six years since the Beginner's Course series was completed, and no reprints are available. Copy of our Fluid Power Engineering Index, published in January 1956, has been sent you. This has a category on textbooks and films. We also publish the FLUID POWER DIRECTORY, *which will be available early in November, priced at $6.50. In it you will find considerable material to assist you.*

Oil-Immersed Solenoids

Kindly inform us where we might obtain more information on oil-immersed solenoid valves, mentioned in the Fabricating Machinery Forum in your July issue.

A. C. SKINROOD
Sandia Corp.
Albuquerque, N. M.

Name of the manufacturer has been sent.

Small Pumps

We are looking for high-speed, fractional horsepower pumps for operating pressures of 2000 psi. In your June issue, in the Turbojet Engine Symposium, you mentioned pumps of this kind. Who manufactures them?

W. M. J. SCHLOSSER
Best, Holland

Manufacturer's name has been forwarded, along with others who make aircraft pumps. ▼▼▼

Circle 107 on Reader Service Card
Circle 129

MEASURE

the hydraulic oil you are using against these properties of STANOIL *Industrial Oil*

1 *Stability* _____

Special solvent-refining techniques and the addition of an exceptionally effective antioxidant give STANOIL Industrial Oil unusual resistance to chemical change.

2 *Good Pour* _____

Oil has got to flow to the pump. STANOIL's low pour point results from selective refining to remove wax. Special additives further lower pour point. STANOIL flows freely from a cold start. System never fails because oil doesn't flow.

3 *Ability to release air* _____

All mineral oils absorb air. Oil in a hydraulic system is especially susceptible to absorption of air. Effective release of air depends much on the degree of refining. Superior refining techniques used in manufacture of STANOIL assure ready release of air. A special antifoam agent further depresses any foam tendencies in STANOIL.

4 *Viscosity* _____

If oil viscosity varies, there's trouble. Oil too thin means excessive slippage or poor oil flow. The pump won't deliver power and there may be excessive wear. Oil too heavy means excessive fluid friction, power loss and sluggish operation. STANOIL has a high viscosity index, is extremely resistant to viscosity change at high or low temperatures, operates just as effectively at start as at full operating temperature.

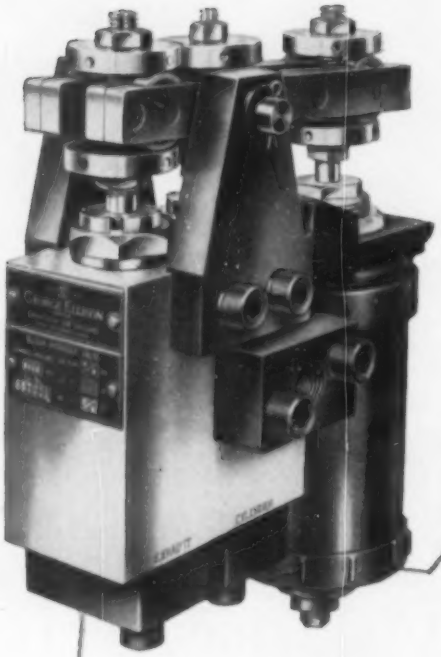
5 *Rust protection* _____

Hydraulic system rust can't be tolerated. Rust scratches valve parts, pistons and other system parts. Rust particles can hold valves open or close off small openings. STANOIL Industrial Oil contains an advanced type of corrosion inhibitor. Inhibitor plates out on metal surfaces, effectively protecting all parts of system.

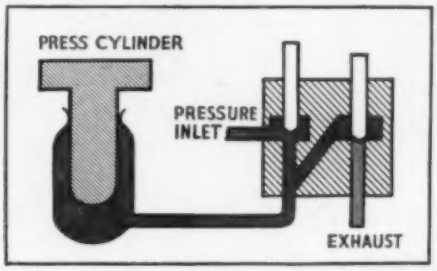
Get all the facts about STANOIL Industrial Oil from the Standard Oil industrial lubrication specialist nearest you in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 So. Michigan Avenue, Chicago 80, Illinois.

STANDARD

STANDARD OIL COMPANY
(Indiana)



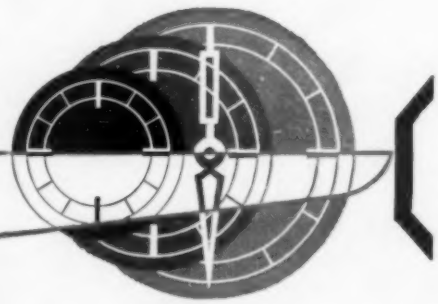
AUTOMATIC CONTROL at low cost



Plain upstroking press working on one fluid pressure with gravity return of the ram.

With very little capital outlay beyond the purchase of a few Ellison valves and suitable timing instruments, many factories can provide themselves with a very effective form of automation. Such an installation enables several hydraulically operated machines to be controlled automatically by a single operator and could well be applied to the automatic control of safety devices and guards.

Ellison valves in themselves mark a real step forward in hydraulic practice, embodying new features to prevent scoring of seats and stems and to ensure trouble-free service with little maintenance. Ask for full details.

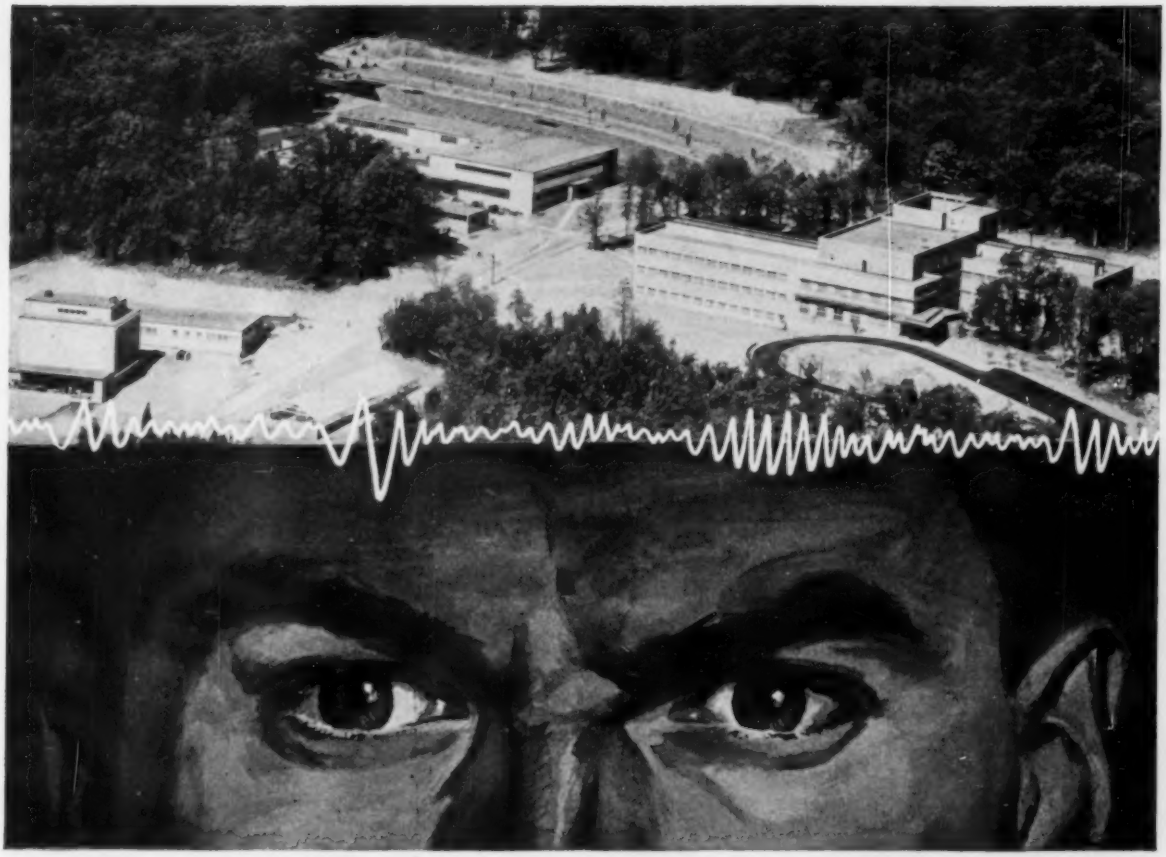


Made by

GEORGE ELLISON
LIMITED

PERRY BARR BIRMINGHAM 22B
ENGLAND

808



Here, creative minds will shape the future

Yes, here in the new Research Center of United States Rubber Company the probing minds of chemists and other scientists will find the ideal environment for conceiving new ideas...the finest facilities for bringing them into reality. Located on a 100-acre tract in suburban Wayne Township, New Jersey, the Center is a concrete symbol of the basic importance of Research in this company's past, present and future.

Significantly, at least 25 of U. S. Rubber's major product lines have been developed within the past twelve years.

As the Chemical Division of U. S. Rubber, Naugatuck Chemical continues to contribute a generous portion of new and improved products . . . such as its compounding method for greatly increasing the ozone resistance of its Paracril® nitrile rubbers.

Such developments stem not only from our research laboratories at Naugatuck, but also from Naugatuck's agricultural research facilities at Bethany, Connecticut, and the laboratories of our Canadian affiliates, Naugatuck Chemicals and Dominion Rubber Company, Ltd. Now, Naugatuck's research will be substantially augmented—and perhaps channeled in radically new directions—by the more fundamental research carried on at the new Research Center.

In the future, even more than in the past, look for the name Naugatuck to identify *the newest and the finest* products in their respective fields!

Naugatuck Chemical

Division of United States Rubber Company, Naugatuck, Connecticut

US RUBBER

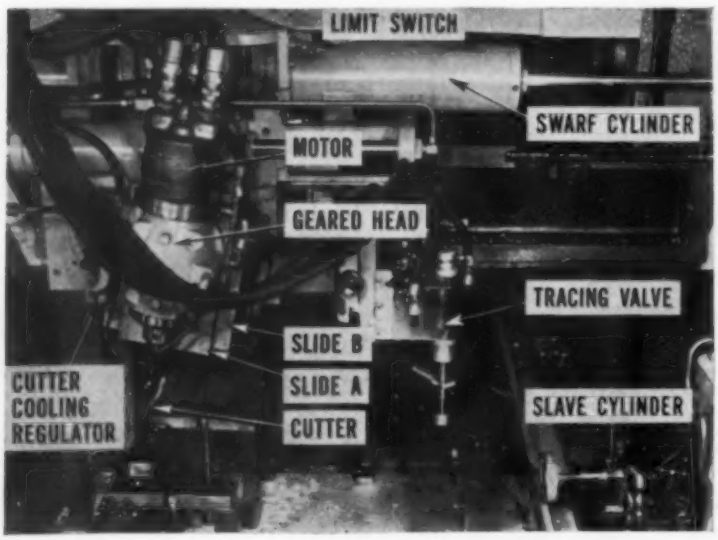
Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices • CANADA: Naugatuck Chemicals Division, Dominion Rubber Co., Ltd., Elmira, Ontario • CABLE: Rubexport, N.Y.

BRIEFS about fluid power

New Spar Mill Cuts Machining Time

A swarfing spar-milling machine has been designed and built to reduce milling time of sculptured aircraft parts. It performs full 360-degree accurate contour milling and tapering in addition to swarfing. Swarfed parts are those with twisted planes of constantly changing angles. The machine is capable of making variable angle cuts up to 24 degrees either side of center line. With completely hydraulic controls, aluminum or stainless steel parts can be produced to tolerances of 0.002-in. Cutters are powered by a 15-hp hydraulic motor. Ranging from 0 to 1800 rpm, cutting speeds are valve-regulated, with cutting action controlled by simple cams. Built by Tapered Air Products Corp., Lynwood, Calif., it machines shapes with contours, circles, and French curves to 16 ft by 4 ft. Additional features include: control panel that swivels to increase work area; use of limit switches to prevent rapid travel of table during cutting; and valve control of table and cutter direction.

In the picture, a stainless-steel spar is being cut. All swarfing is accomplished by pivoting from any given point on the cutter. By actuating slide *A*, it is possible to compensate for any change in the length of cutter. After changing to a larger or smaller diameter cutter, actuating slide *B* brings the pivot point back to the cutting edge. The slave cylinder controls the angle of the swarf cut. The 360 degree tracing valve controls all side movements. Regulators allow operator to control the amount of mist used for cutter cooling. ▼▼▼



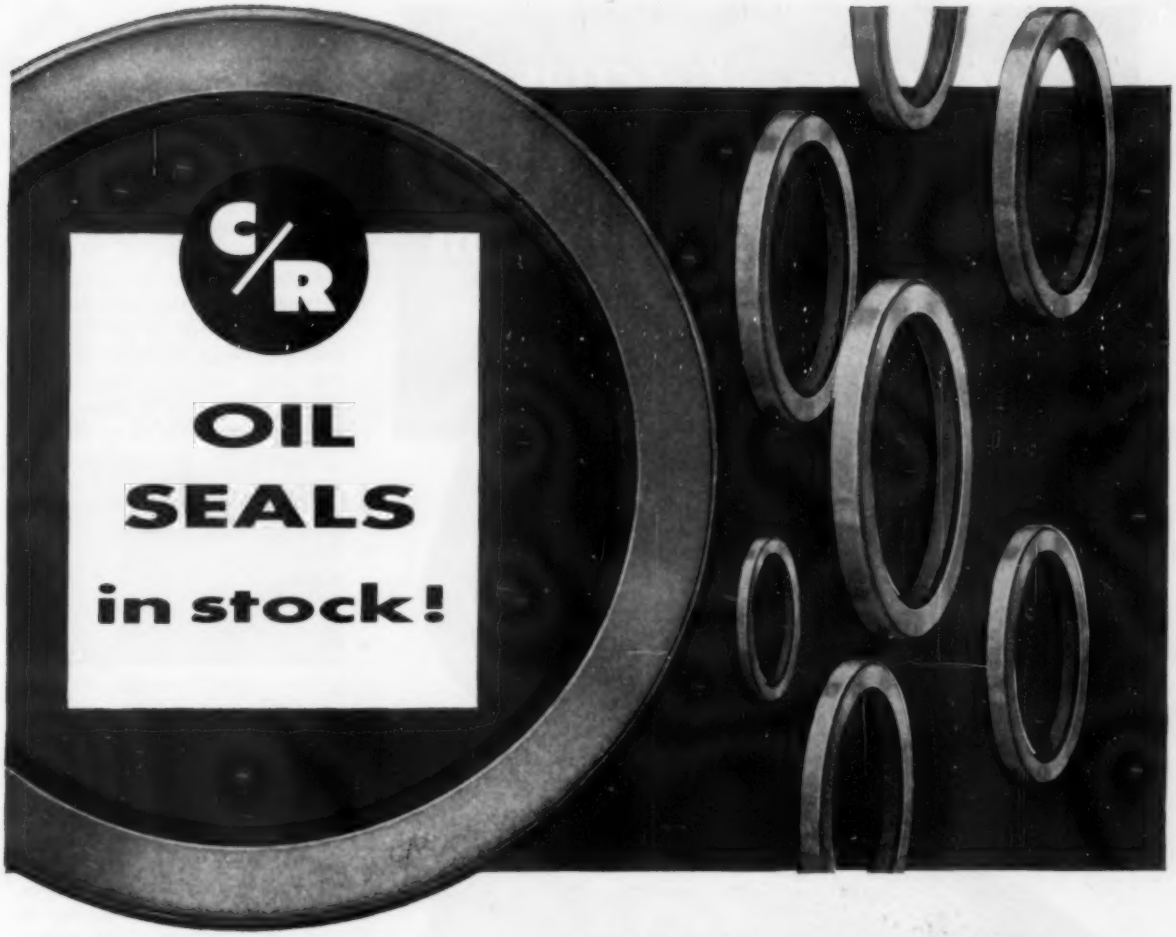
Film Shows Need For Proper Oil

"Hydraulic Oils", a 25-minute sound-on-film color motion picture, released by The Texas Company, shows the principles of hydraulic laws and demonstrates the vital part premium oils play in getting top performance and increased production from the many applications of hydraulics in industry today. The many applications of Pascal's discovery are reviewed pictorially, and his essential idea is demonstrated in a glass model of a basic power system. Profitable performance of premium hydraulic oil depends on a few simple precautions which are explained in the film. ▼▼▼

Hydraulic Power Steers and Digs

Steering is easy on the new, hydraulic, 12-ton motor scraper developed by Allis Chalmers Mfg. Co., Milwaukee. This machine features two-speed hydraulic steering, with 90-degree steer each way. With only one-sixth turn of

Continued on page 34



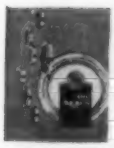
Thousands of sizes . . . available for prompt delivery

Whenever you face the problem of finding the right oil seal quickly . . . in extensive or limited quantity . . . check C/R.

More than 20 types, forming over 7,500 size combinations for shafts from ¼" to 50" O.D. are available—the majority from stock! C/R shaft type oil seals fit most seal applications . . . from simple dust exclusion to high-speed, high temperature fluid retention under extremely rugged operating conditions where high sealing efficiency must be maintained over long service life.

Check C/R . . . you'll find the seal to solve your problem available from stock in most cases. Or C/R engineers will gladly offer their unrivaled experience and facilities to create and produce special designs.

More automobile, farm and industrial machines rely on C/R Oil Seals than any other similar sealing device.



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DARCOVA PUMCUPS

now available with

100% NYLON COMPOSITION

for HYDRAULIC CONTROLS, AIR CYLINDERS, RECIPROCATING PUMPS

Darcova 45° Bevel Type Pumcup

DARLING Pumcups—long noted for unequalled efficiency and life in all kinds of cylinders—are now greatly exceeding their own performance records! The new 100% Nylon Composition, available *only* in Darcova Pumcups, does it!

Nylon Pumcups are made in sizes, types and textures exactly right for your particular equipment—ready *now* to give you unprecedented piston packing performance!

Write for helpful data Bulletin No. 5503.

DARLING VALVE & MANUFACTURING CO.

Williamsport 15, Pa.

DARCOVA

THE ORIGINAL COMPOSITION CUP

TRADE MARK

PUMCUPS

BRIEFS / continued

the wheel, the operator can swing into a right-angle turn, and a complete, non-stop turn can be made in a little over 24 feet. For smooth, gradual turns on haul roads, a slight turn of the steering wheel regulates the pump flow to the hydraulic steering cylinders.

A relief valve in the steering system protects the hydraulic system from excessive shock loads if one of the tractor wheels hits an obstruction. Full-flow filtering

insures clean hydraulic fluid in the lines and efficient operation of all controls.

The "bowl" or dirt scoop, is also controlled hydraulically. Two powerful, double-acting, hydraulic cylinders exert downward pressure at the cutting edge for fast penetration of the hardest materials, and for rapid action in lifting the bowl out of the ground. When "spreading" or unloading, the hydraulically powered ejector buildozes the material out of the bowl.

All controls, including the hydraulic scraper controls, are within easy reach of the operator. One lever raises and lowers the bowl, and another provides instant and positive control of the apron and ejector. ▼▼▼

Test Lab Has High-Pressure Facilities

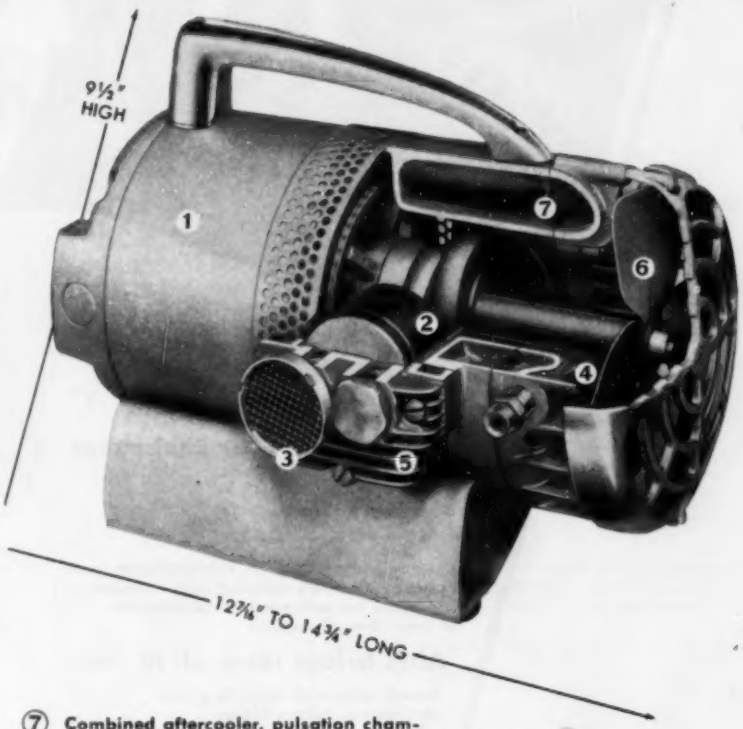
Unable to find available equipment sufficiently versatile for their requirements, Sinclair-Collins Valve Co., Akron, Ohio, designed and developed much of the equipment for their test room. The new facilities include latest types of precision measuring and evaluating equipment for high-pressure pneumatic and hydraulic valve operation. High flow rates up to

Continued on page 36

Oil-Free COMPRESSED AIR

from a portable or built-in unit

No more oil-spoiled work! Here is a compressor which doesn't require lubrication of any kind—eliminates an oil separator, *ends expensive lubrication maintenance!* Whether your need is for a portable or built-in source of compressed air, the compact, lightweight B&G Oil-less Compressor assures cleaner, cooler, drier air and smoother operation.



① **Specially designed motors.** Built by B&G—noted for dependabi lity. Ball bearings are *permanently* grease packed.

② **Graphite piston rings and skirts.** Made of a special composition which does not need lubrication. Operate for years without destroying the mirror-finish of the cylinder walls. Piston ring joints are self-sealing—reduce blow-by to a minimum.

③ **Dry valve construction.** Inlet and exhaust valves are positive-sealing without presence of oil. Precision lapped—self-cleaning—no rubbing parts.

④ **Safety valve.** (Not visible.) Provides constant bleed-off at maximum pressure. Also acts as automatic moisture drain.

⑤ **Bi-metal cylinder head.** Deep-finned aluminum head transfers heat faster. It is cast around the cast iron cylinder, making a leak-proof shrink-fit...no gasket needed.

⑥ **Blast cooled.** The fan blasts great volumes of air over the pulsation chamber, connecting rods, bearings, cylinders and motor. Low temperature operation assures higher efficiency, longer life.

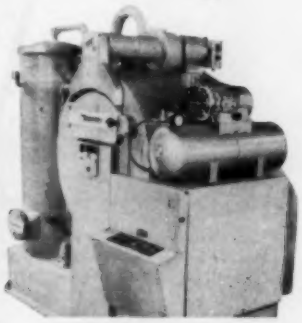
⑦ **Combined aftercooler, pulsation chamber, moisture separator.** Cooler, drier air is delivered at smooth, uniform pressure because of this integrated design.

For complete information on B&G Oil-less Compressors and Vacuum Pumps, send for Catalog GO-1156

Cart mounted B&G Air Compressor

B&G "Duplex Unit" mounted on horizontal tank

New type air stapler with air supplied by B&G Compressor



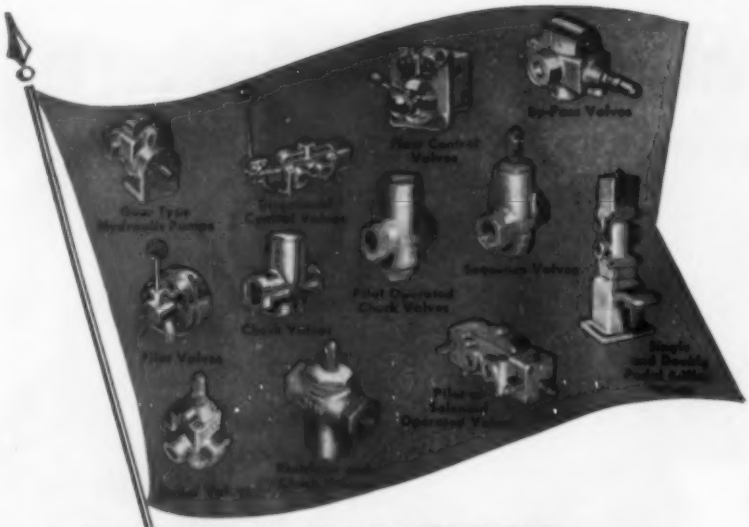
B&G Compressor built into dry cleaning machine

Oil-less AIR COMPRESSORS

BELL & GOSSETT COMPANY

Dept. EZ-66, Morton Grove, Illinois

MAKERS OF HEATING AND COOLING SPECIALTIES, PUMPS, HEAT EXCHANGERS



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ADEL *Refinements* assure Plus Performance for Your Equipment

Designers and Engineers have set these standards for Industrial Hydraulic Equipment

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ADEL brings them all to you!

Smooth economical hydraulic power for Pushing, Pulling, Lifting, Pressing, Clamping and Controlling.

Illustrated are but a few of a wide variety of ADEL industrial hydraulic control equipment that offer definite benefits to both the user and builder of machine tools and many other kinds of equipment. ADEL products incorporate proven design and precision construction features that assure dependable operating efficiency over the years. A complete line for every application.

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BRIEFS continued

500 gpm are available for checking steady state flow conditions on valves up to 6-in. pipe size. Dynamic hydraulic testing can be done at pressures up to 5000 psig.

at flow rates as high as 35 gpm. Various field conditions, such as controlled back pressures encountered in working cylinders, can be simulated, and simultaneous two-pressure performance can also be checked. ▼▼▼

Fluid Power—the Muscle of Automation

. . . will be discussed by John J. Pippenger at the October meeting of the Philadelphia Chapter of the American Society of Mechanical

John J. Pippenger

Engineers. Meeting will be held at the Engineers' Club, Philadelphia. Tuesday evening, October 22nd. Well-known in the fluid power field as an authority on hydraulic valves and circuits, Pippenger is Vice-President of Engineering at Double "A" Products Corporation, Manchester, Michigan. ▼▼▼

Continued on page 38

PUROLATOR FILTERS FOR THE PROTECTION OF HYDRAULIC CIRCUITS

G-200M Aircraft Restrictor Filter two-way for hydraulic oil systems metal element

PR 301 ½ GPM line type hydraulic oil filter Micronic element

PR 362 3 CFM in-line vent type Micronic element

G 200 series in-line two-way restrictor filter Metal element, internal connections

PR 312 12 GPM line type filter Micronic element

PR 412-8 12 GPM line type filter Military approval

G-187 3 GPM in-line hydraulic oil filter Metal element

P 32-26 Low pressure, high flow hydraulic oil filter

Effective filtration is essential for optimum performance in hydraulic circuits. To keep a system clean and functioning properly, it is important that the filter be designed specifically to meet the requirements of the job.

Purolator's complete line of filters for hydraulic systems includes models for every set of operating conditions likely to be encountered. A few are shown here; there are many more standard models from which to choose. If your application requires a special filter, Purolator will design and build it. Let Purolator work on your toughest filtration problem.

Filtration For Every Known Fluid

PUROLATOR

PRODUCTS, INC.

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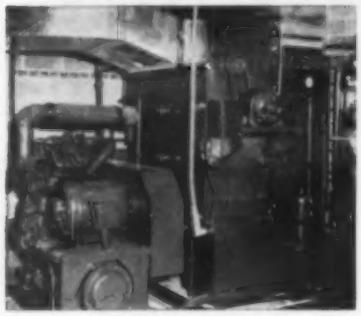
DRY AIR...
PRECISELY AS YOU WANT IT



The Niagara Controlled Humidity Method using HYGROL Moisture-Absorbent Liquid

is best and most effective because... it removes moisture as a separate function from cooling or heating and so gives a precise result constantly and always.

Most reliable because... the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions.

Most flexible because... you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

AT THE
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See NIAGARA...
AIR CONDITIONERS • Aero HEAT EXCHANGERS
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Aero VAPOR CONDENSERS • HUMIDIFIERS
HEATERS • COOLERS • DRYERS
BOOTH No. 655

Write for full information; ask for Bulletins 112 and 121. Address Dept. AH

NIAGARA BLOWER COMPANY
405 Lexington Ave., New York 17, N.Y.
District Engineers in Principal Cities of U. S. and Canada

BRIEFS continued

Ninth Annual AIEE Machine Tool Conference

. . . will be held November 4-6, at Hotel Schroeder, Milwaukee, Wis. Program will include inspection trips to several industrial plants in the area. During technical sessions over the three-day period, topics discussed will cover: need for better machine tools, automatic positioning and gaging methods, static control, pancake and squirrel-cage synchronous and spindle motors, and practical solutions for a variety of machine tool applications. For information write F. L. Fisher, Registration Chairman, c/o Allen Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis. ▼▼▼

Continued on page 42

BRIEF NOTES

NYLON PRESSURE TUBING . . . ⅛ to ½-in. OD for 1000 and 2500 psi, flared and flareless fittings, is being produced at the U. S. Gasket Co. Plastics Division of Garlock Packing Co., Camden, N. J. Details in New Products Section.

HYDRAULICS SCHOOL . . . for supervisory personnel, is being conducted by J. N. Fauver Co., Inc., Detroit. According to Carl S. Abbott, president of Fauver, the school fills a need for basic industrial hydraulics instruction at the middle management level. Initial response has been over-whelming.

MOTORIZED RELIEF VALVE ACTUATOR . . . mounting directly in place of the hand adjustment, is manufactured by United Hydraulics, Inc., Dayton, Ohio. Unit is light, compact, and provides ease and accuracy of setting. See New Products Section for details.

SCIENTISTS FORM RESEARCH TEAM . . . ten former MIT staff members have formed Hydel, Inc., an independent research and development organization to serve general industry. American Brake Shoe Co. is providing financial assistance only.

BUSINESS BRIEFS

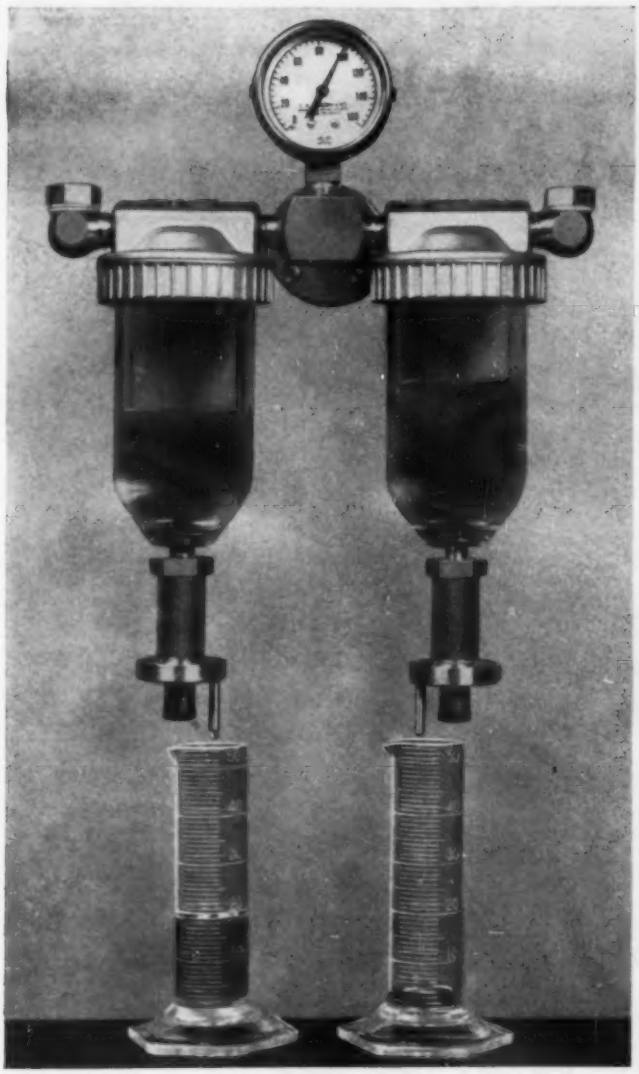
PROFITABLE HALF YEAR . . . the first since 1954, was reported by Edward M. Greer, president of Greer Hydraulics, Inc. The company has sold two of its subsidiaries and is concentrating its efforts in fields where it excels.

PARKER APPLIANCE ACQUIRES HANNIFIN . . . S. B. Taylor, president, Parker Appliance Co., Cleveland, and E. G. Peterson, president, Hannifin Corp., Des Plaines, Ill., announced an agreement for Parker to purchase all stock of Hannifin for approximately $7½ million.

OVER $21 MILLION SALES . . . in the first half of 1957 were reported by Charles W. Anderson, president, American Machine & Metals, Inc. He also reported purchase of Hunter Spring Co., Lansdale, Pa.

SHARP RISE IN EARNINGS . . . for Norden-Ketay Corp., Stamford, Conn., in the first half of 1957, was announced by Perry R. Roehm, president. Current defense economy drive has not affected operations due to increase in customers served.

SALE OF BELLOWS CO., AKRON . . . and its affiliated companies and divisions, to International Basic Economy Corp., N. Y., was announced by Nelson A. Rockefeller, president IBEC, and H. B. Link, president of Bellows.



ANTILEAK DEMONSTRATION

Suntac oil in one chamber, your present hydraulic oil of the same viscosity in the other. Both oils are forced out through sintered bronze bearings. In this photograph, pressure of 100 psi caused a straight mineral oil to leak out four times faster than Suntac.

SUNTAC CUTS HYDRAULIC OIL LOSS AS MUCH AS 75%

See this demonstration in your plant

Take about five minutes at your own desk to learn how Suntac® oils stay put in hydraulic systems . . . reduce oil loss through loose joints and worn fittings.

Match Suntac against the hydraulic oil you're now using—see how the exceptional non-gummy antileak characteristics of Suntac can reduce your oil losses as much as 75%. *Some users have even reported savings of 90%.*

Call Your Sun Representative

Have him arrange with a Sun Lubrication Engineer to give you and your staff a private demonstration. For further information on the uses of Suntac in hydraulic systems and in general lubrication, write to SUN OIL COMPANY, Philadelphia 3, Pa., Dept. AH-10.

SUNOCO

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY PHILADELPHIA 3, PA.

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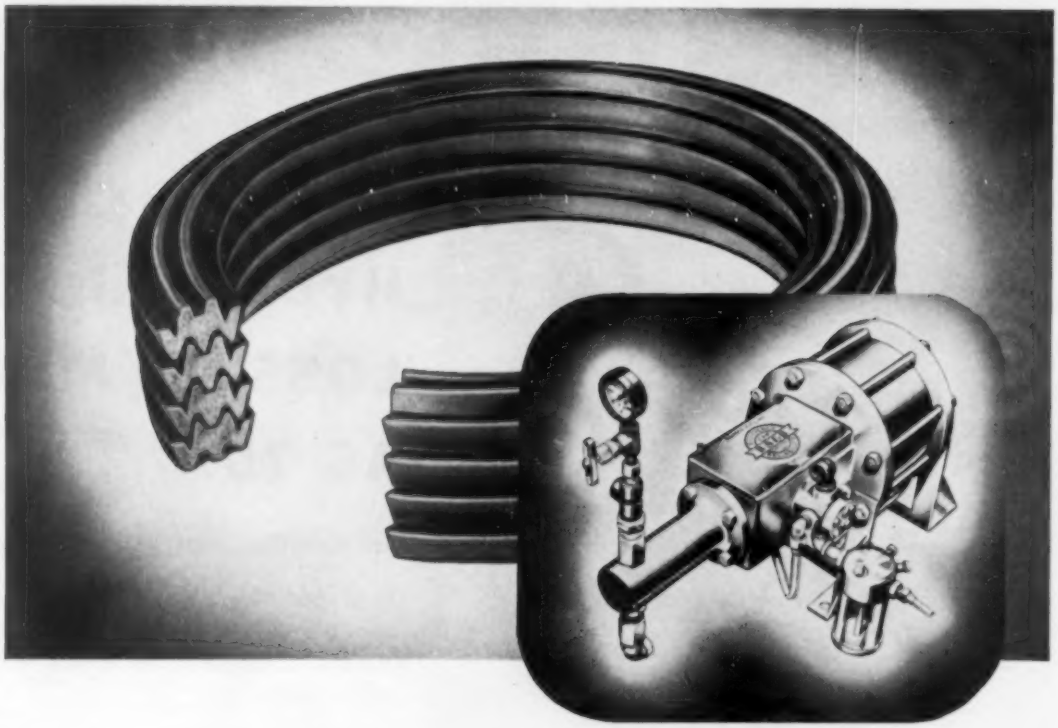
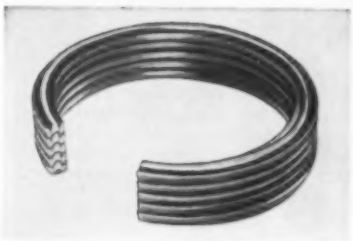
IN CANADA: SUN OIL COMPANY LIMITED, TORONTO AND MONTREAL

J-M Uneepac® does it again!



"Very satisfactory sealing service against wide variety of fluids and pressures up to 5,500 psi"

says Black, Sivalls and Bryson, Inc. makers of BS&B Glycol Pump



Uneepac comes in two types. Shown here is design for flange widths up to ½" which is used in BS&B Glycol Pump. Large illustration above shows design for flange widths over ½".

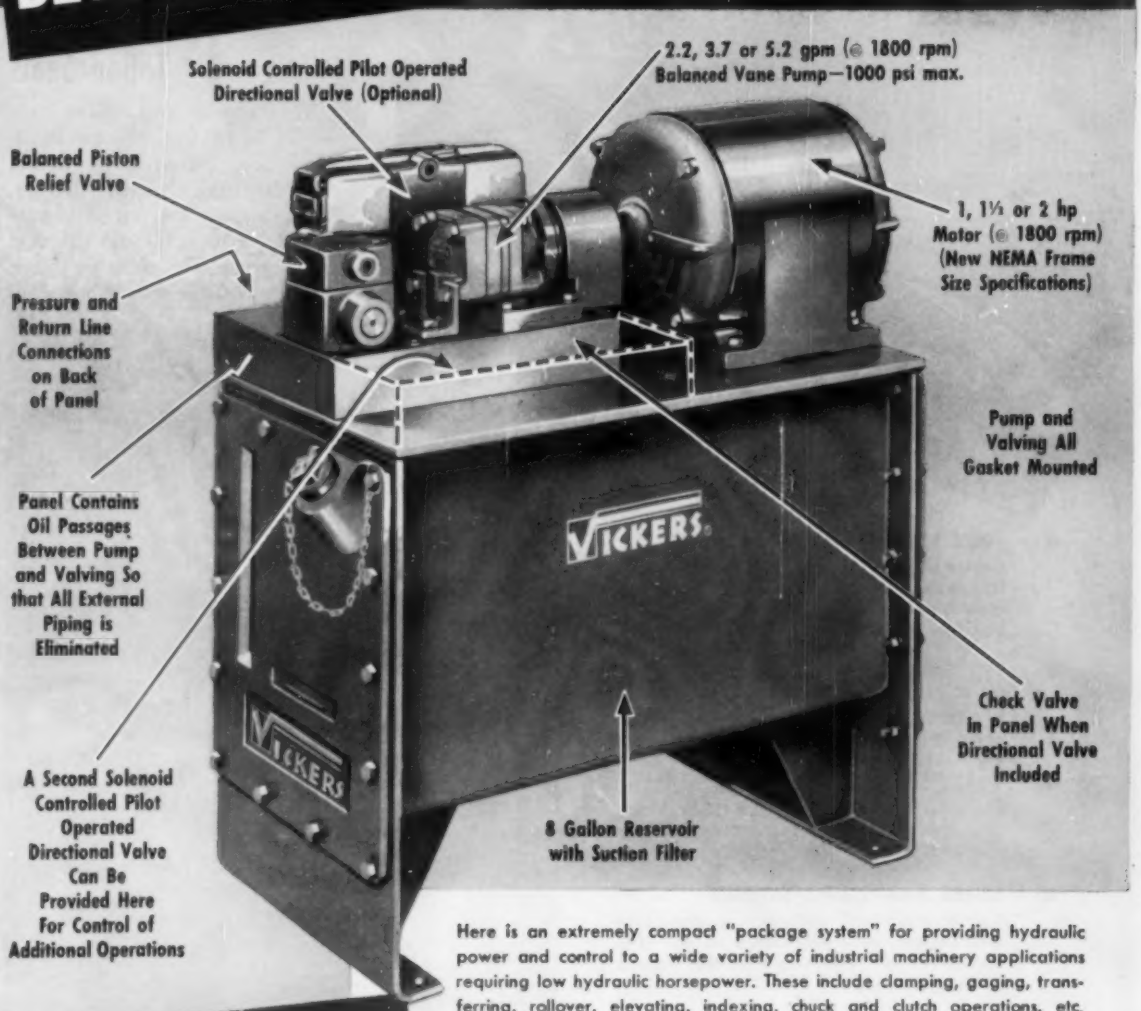
Chalk up another success story for Uneepac—Johns-Manville's automatic ring packing. In the BS&B Glycol Pump, fluids handled include triethylene glycol, diethylene glycol, gasoline, and various types of oils, alcohols and petroleum treating chemicals. Working pressures range from 125 psi to 5,500 psi with average operating pressures at 3,000 psi. Yet despite these rugged service conditions, Uneepac has delivered—in Black, Sivalls and Bryson's own words—"very satisfactory service."

Many other packing users have acclaimed J-M Uneepac for its long, trouble-free service. Each ring is a complete packing unit. Fewer rings are needed than ordinarily required and stuffing box size can be reduced to the minimum. Each ring centers itself automatically on the preceding ring to simplify installation. This exclusive design also permits fluid pressure to act upon each lip individually and protects lips from excessive gland pressure.

J-M Uneepac comes in a wide range of styles and sizes for many rod and plunger applications. For further information write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

Johns-Manville PACKINGS, GASKETS and TEXTILES

BETTER DESIGN . . . in hydraulic power and control systems


Solenoid Controlled Pilot Operated Directional Valve (Optional)
2.2, 3.7 or 5.2 gpm (@ 1800 rpm) Balanced Vane Pump—1000 psi max.
Balanced Piston Relief Valve
1, 1½ or 2 hp Motor (@ 1800 rpm) (New NEMA Frame Size Specifications)
Pressure and Return Line Connections on Back of Panel
Pump and Valving All Gasket Mounted
Panel Contains Oil Passages Between Pump and Valving So that All External Piping is Eliminated
VICKERS
Check Valve in Panel When Directional Valve Included
A Second Solenoid Controlled Pilot Operated Directional Valve Can Be Provided Here For Control of Additional Operations
8 Gallon Reservoir with Suction Filter

Here is an extremely compact "package system" for providing hydraulic power and control to a wide variety of industrial machinery applications requiring low hydraulic horsepower. These include clamping, gaging, transferring, rollover, elevating, indexing, chuck and clutch operations, etc.

Note the many features indicated on the photograph above. The result is improved and simplified hydraulic design . . . also reduced installation and maintenance costs. This "package system" has great flexibility . . . is available in a wide variety of combinations of standard components assembled to suit individual requirements. Pretested and ready for immediate operation, it has also the advantage of undivided Vickers responsibility. For further information, ask for installation drawings 178706-8.

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Series T8
HYDRAULIC
PIPELESS
POWER PACKAGE*

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IN CANADA: Vickers-Sperry of Canada, Ltd., Toronto

*These "package systems" supplement the Vickers line of standard hydraulic power units.

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

HERE'S WHY **CARTER** CAN OFFER
IMMEDIATE DELIVERY
ANY BORE SIZE • ANY MOUNT • ANY STROKE
CYLINDERS
AIR OR HYDRAULIC

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- **100% EXPANSION OF FACILITIES**
  Carter is geared to give service. We have increased our plant capacity to handle orders on an IMMEDIATE DELIVERY basis.
- **THE EXCLUSIVE CARTER DESIGN**
  Carter cylinders are designed for fast production and immediate off-shelf assembly from standard parts.
- **THREE SHIFT OPERATION**
  Carter produces around the clock. Your order for cylinders is in process *in a matter of minutes* after we receive it.
- **SPARE PARTS AND SERVICE**
  Carter maintains complete spare parts and experienced engineers in 40 different locations throughout the United States, Canada, and Mexico.
- **PHONE 24 HOURS A DAY**
  Call in your order any time of the day or night. Carter will take your order and begin processing it right away.

If you need cylinders fast, try us today.

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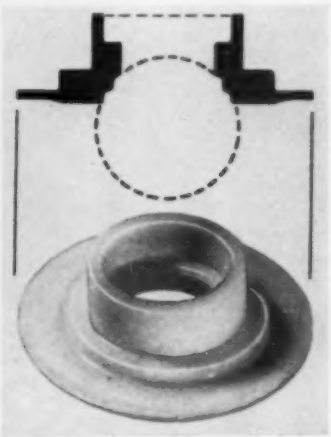
ROTARY ACTUATORS • SPECIAL CONTROLS

BRIEFS continued

New Molding Process Produces Thin Teflon Seals

Thin articles are molded from Teflon by a new process developed and patented by Sparta Manufacturing Company, Dover, Ohio, without loss of uniformity or tolerances, and with freedom from cracks. The effect of plastic memory is minimized, waste of



material is avoided, and mass production at reduced costs is achieved.

• **Uses**—Items already developed include O-rings, cup seals, piston wipers, ball seals, valve and shaft seals, diaphragms, shields, and gaskets. This process opens the door to many product-improvement and cost-reduction opportunities, particularly in the field of leakage control. Advantage can be taken of Teflon's

Continued on page 44

Unmatched For Positive High Pressure Control

Yes, there's more than one reason why Weatherhead Ermeto is so widely used for today's high pressure hydraulic tube connections. Unequalled for resistance to vibration, high temperature and high pressures, it is installed quickly and easily with only the use of a wrench. Its versatility fits it into practically any modern, high pressure application. Men designing for the future specify today's most versatile hydraulic fitting . . . . Ermeto.

ERMETO 7000 SERIES

Weatherhead "7000" series Ermeto meets all S.A.E. standards for hydraulic flareless tube fittings. In addition to a complete range of standard body styles, the "7000" series Ermeto includes all the popular straight thread body styles to fit the S.A.E. approved "O" ring boss mounting. All "7000" Ermeto Fittings and components are treated with the exclusive *Weathercote Finish. Distributors coast to coast.

*"Weathercote" is the exclusive Weatherhead trade name for a special rust preventative, corrosion-resistant black phosphate finish which meets S.A.E. standards.

THE WEATHERHEAD CO., FORT WAYNE DIVISION
Dept. A-10, 128 W. Washington Blvd., Fort Wayne, Indiana
In Canada: The Weatherhead Co., Ltd., St. Thomas, Ontario

Circle 151 on Reader Service Card

UCON
BRAND
HYDROLUBES

HELP

PROTECTION The fire-resistance of CARBIDE's fire-resistant hydraulic fluids has been proved by severe, exhaustive laboratory tests. And, in actual service, water-base UCON hydrolubes have prevented serious fires and injuries during more than 10 years of routine use in all types of industrial hydraulic equipment. The common fire hazards connected with hydraulic operations are eliminated when UCON hydrolubes are used. UCON hydrolubes are classified as acceptable, less hazardous fluids by Factory Mutual Laboratories.

ECONOMY UCON hydrolubes 150-CP and 275-CP are the economical answer to fire-resistance in hydraulic fluids. Most commercial hydraulic equipment can be easily converted to UCON hydrolubes with a minimum of time and expense. UCON hydrolubes have no harmful effects on most packings or seals. In fact, in many instances, reduced leakage losses have been reported. UCON hydrolubes also provide maximum protection against liquid and vapor phase corrosion and have outstanding anti-wear characteristics—thus, pump replacement costs are also held to a minimum.

Why not get all the facts on how UCON hydrolubes can mean protection plus economy for you. Write today for the booklet, "UCON Hydrolubes Spell Safety," F-40134.

UNION CARBIDE CHEMICALS COMPANY

Division of UNION CARBIDE Corporation

30 East 42nd Street, New York 17, N. Y.

"Ucon" is a registered trade-mark of UCC.

BRIEFS / continued

properties of chemical inertness, corrosion resistance, heat resistance from —450 F to 500 F, toughness, high dielectric strength, low co-efficient of friction, non-adhesiveness, and non-absorbance.

• **Production**—The new process has already been applied to manufacture Teflon articles as thin as .006-in., in rapid, economical production, with close tolerances, uniform and free of cracks, and with little or no material waste. Even thin cross-sections having undercuts or return recesses can be molded to relatively close tolerances. ▼▼▼

Hydraulic Cylinders, operating at 3000 psi, supply a 225,000-lb. forming force to each of two opposed rollers on this Spin-Forge, developed by Hufford Corporation, El Segundo, California. Machine forms parabolic, hemispherical, conical, hour-glass and other shapes from one piece.

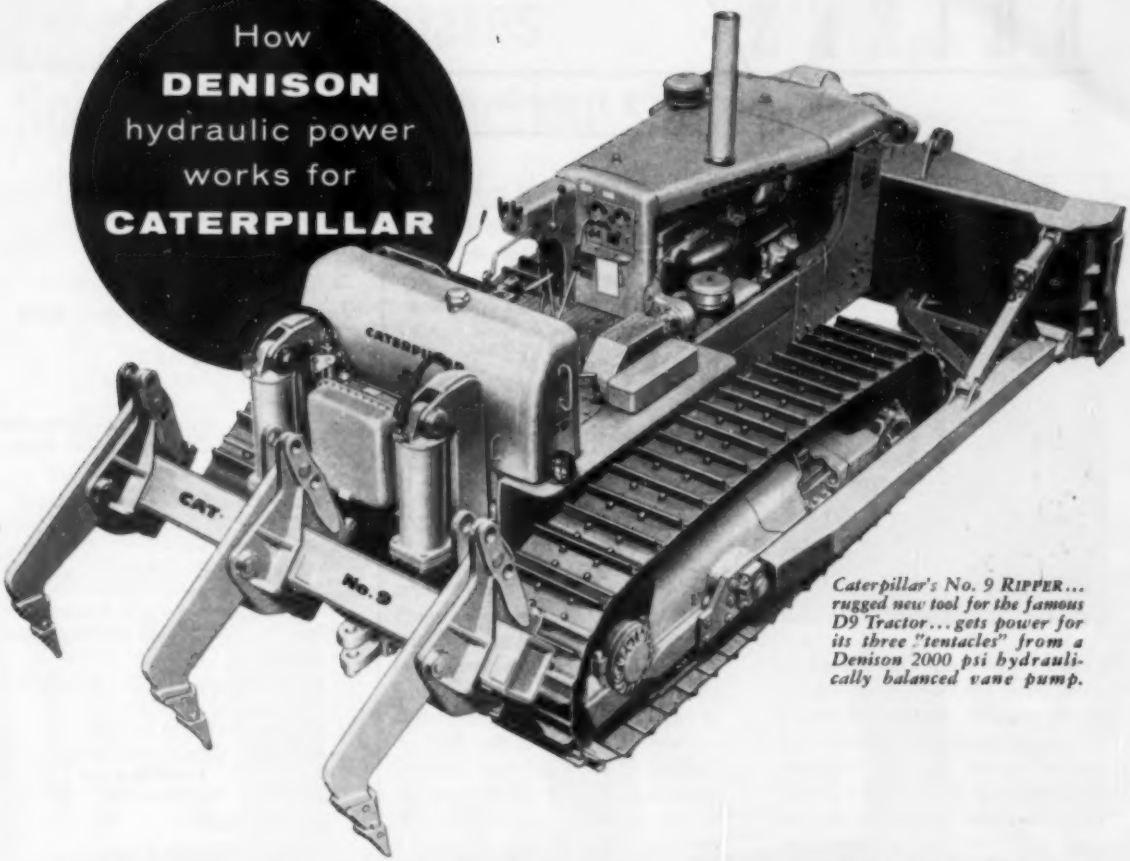
Two-Pump Hydraulic System Eliminates Sequence Valves

This hydraulically powered, combination punch press and multiple bender was designed by Walter P. Hill, Inc., Detroit, utilizing unique press bending principles to simultaneously pierce and countersink holes, flatten, coin weld projections, and produce multiple bends in two tubular parts at a time at a high production rate.

• **Operation**—The hydraulically powered ram advances at high speed under low pressure, and

Continued on page 46

How **DENISON** hydraulic power works for **CATERPILLAR**



Caterpillar's No. 9 RIPPER... rugged new tool for the famous D9 Tractor... gets power for its three "tentacles" from a Denison 2000 psi hydraulically balanced vane pump.

PUTTING TEETH IN THE "RIPPER"

...another application for DENISON hydraulic power

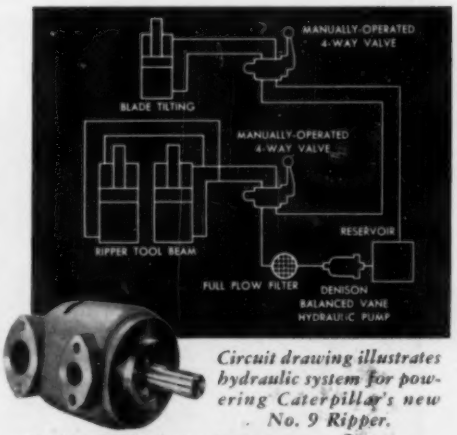
Caterpillar's rugged No. 9 Ripper—newest tool designed for their powerful D9 Tractor—proves again the basic design advantages of Denison's 2000 psi vane-type hydraulic pump.

The Ripper's three working shanks are powered by the Denison "T" series pump—capable of delivering up to 2000 psi continuously. Driven by the engine power take-off, the Ripper's pump actually operates at 1450 psi (relief valve setting) which provides generous reserve stamina to withstand heavy workloads with no danger of breakdown. With the Denison "T" series pump, Caterpillar designers assured the owner of cold-weather pump-starting ability without damage to the pumps. They assured speedy servicing in the field because the complete pumping cartridge is removable as a unit. It all adds up to *lower operating cost* and dependable performance.

There's less weight, less cost-per-horsepower—with smaller lines and valves with the Denison 2000 psi pump as the heart of a hydraulic system. Design flexibility is unlimited.

Have your Denison hydraulic specialist tell you more about the 2000 psi pump—and help you with any equipment or machinery design problem. Write Denison Engineering Division, American Brake Shoe Co., 1166 Dublin Road, Columbus 16, Ohio.

DESIGNERS—ENGINEERS! New Bulletin 201 describes "How to Design More Efficient Hydraulic Power Into Mobile Machinery." Write us.



Circuit drawing illustrates hydraulic system for powering Caterpillar's new No. 9 Ripper.

Denison 2000 psi vane-type hydraulic pump.

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

DENISON HydrOILics

Denison and Denison HydrOILics are registered trademarks of Denison Eng. Div., ABSCO

BRIEFS continued

performs pressing and bending operations under high pressure. At the same time, the parts are clamped in rigid, accurate location. As the three rams retract,

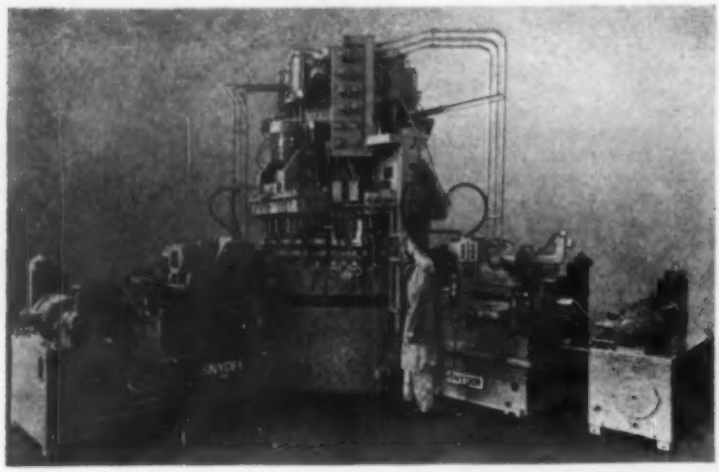
finished parts are transferred to a conveyor for the next operation.

● **Hydraulic system**—Using a two-pump hydraulic system, sequence valves are not required. The high and low-pressure pumps both feed the system under no-load conditions to provide high ram speeds. During the piercing, forming and clamping operations, where high pressures are required, the low-pressure pump is automatically cut out, leaving the high-pressure pump in the system to provide large clamping forces. Subsequent bending and sequencing operations utilize the low-pressure pump maintaining the clamping forces. Both pumps combine to feed the system during ram return when fast action is desired. ▼▼▼

Universal Transfer Device Is Hydraulically Operated

This industrial robot is called the "Planobot", and can simulate just about everything a man's arm, wrist and hand can do. Developed by Planet Corporation of Lansing, Michigan, for handling of hot castings from a die casting machine, this unit is the only industrial robot that can perform more than five or six movements. It can readily be converted to an entirely different cycle to make it universal within the scope of its physical limitations. As an example of American ingenuity, the Planobot was displayed at St.

Continued on page 50



Hydraulic power controls clamping in the 16 fixtures on this machine. Snyder Tool & Engineering Co. used hydraulics for accuracy and heavy duty in designing this unit to produce automotive steering gear ball nuts at 331 pieces per hour.

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For Immediate Delivery!

Over $1,000,000 In ASCO Solenoid Valves Regularly Maintained In Stock

2-WAY

Normally Closed and Normally Open
Pipe Sizes: ⅛"—2"
Pressures: to 1500 P.S.I.
Voltages: 115-230-460/60
Solenoids: General Purpose, Watertight, Explosion Proof
Services: Air, Water, Oil, Gas, Steam

3-WAY

Normally Closed and Normally Open
Pipe Sizes: ⅛"—½"
Pressures: to 600 P.S.I.
Voltages: 115-230-460/60
Solenoids: General Purpose, Watertight, Explosion Proof
Services: Air, Water, Oil, Gas, Steam

4-WAY

Pipe Sizes: ¼"—1"
Pressures: to 300 P.S.I.
Voltages: 115-230-460/60
Solenoids: General Purpose and Explosion Proof
Services: Air, Water, Oil

HAND RESET

2-WAY

Pipe Sizes: ½"—1"
Pressures: to 250 P.S.I.
Voltages: 115/60
Solenoids: General Purpose
Services: Air, Water, Oil, Gas

3-WAY

Pipe Size: ⅜"
Pressures: to 250 P.S.I.
Voltages: 115/60
Solenoids: General Purpose and Explosion Proof
Services: Air, Water, Oil, Gas

STRAINERS AND FILTERS

Pipe Sizes: ⅛"—3"
Pressures: 250 P.S.I.; 450°F
Services: Air, Water, Oil, Gas, Steam

Special purpose solenoid valves and accessories are also stocked.

All sizes and types of ASCO Solenoid Valves now carried in stock by our warehouse in Los Angeles, and by stocking distributors in all principal cities.

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ASCO

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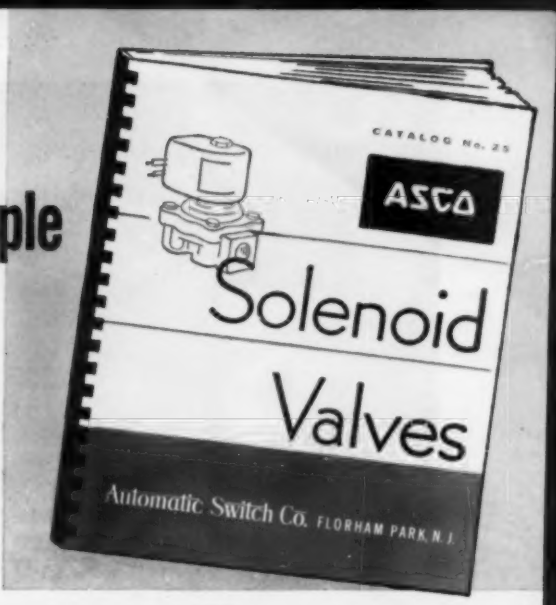
ASCO makes Solenoid Valve selection simple

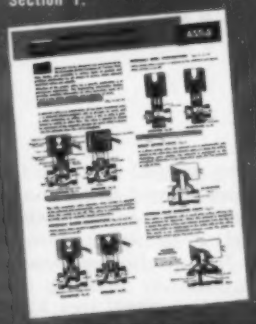


Comprehensive Design Engineering Data Now Available
Keys Proper Solenoid Valve to Application

Specifically designed to make the selection of solenoid valves simple, the ASCO Valve Catalog gives you the most comprehensive engineering data available to aid you in your solenoid valve selection.

Here are 114 pages of up-to-date valve information. These pages incorporate detailed engineering sections. Finding the proper valve for your particular application is made easy by a simple *master index* which leads you to a *separator* where you will find all the valves of the type you require. Each *separator* has a more detailed *index* which will enable you to turn right to the *valve bulletin* needed to meet your particular requirements.

Section 1.



GENERAL ENGINEERING INFORMATION
Expanded engineering data with diagrams, gives valve construction, operating principles, features. With nomographs using Cv ratings for valve sizing.

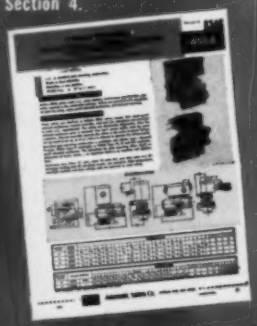
Section 2.

2-WAY VALVES
Covers all 2-way valves of the fully automatic type for a wide range of pipe sizes and pressures.

Section 3.

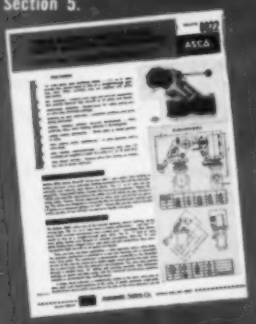
3-WAY VALVES
Detailed information on fully automatic valves for pilot control of diaphragms or cylinders, or for diverting flow in pipelines.

Section 4.



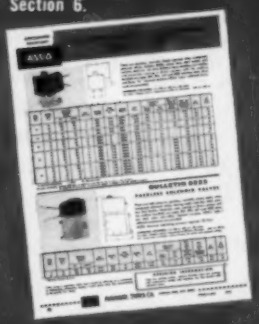
4-WAY VALVES
Fully automatic types covered. Both single and dual solenoid construction for general purpose and J. I. C. requirements.

Section 5.



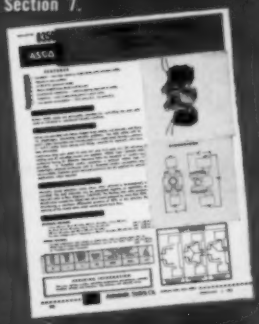
MANUAL RESET VALVES
2 and 3-way solenoid valves for safety shut-off applications.

Section 6.



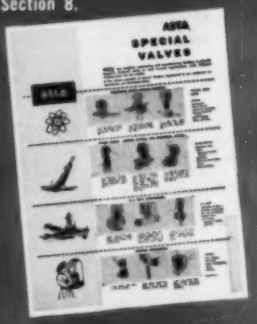
CORROSION RESISTANT VALVES
Includes 2 and 3-way solenoid valves for handling corrosive gases and liquids. Section incorporates a selection guide chart.

Section 7.



SPECIAL PURPOSE VALVES AND ACCESSORIES
Special purpose equipment: waterproof and explosion proof solenoids, laundry valves, cylinders, etc.

Section 8.



NUCLEAR VALVE DATA
Shows ASCO specialized solenoid valve designs for nuclear, guided missile, Navy and dispensing applications.

You may order the complete catalog or individual sections or bulletins. You will find easy to use return reply cards in each catalog for ordering additional literature. Also available is the Electromagnetic Control Master Catalog 57-S or any one of the six sectional Catalogs covering Automatic Transfer Switches, Remote Control Switches, Contactors, Relays, Solenoids or Electric Plant Controls.

Any of these important engineering reference aids may be obtained by writing Automatic Switch Company – *on company letterhead only please.*

Automatic Switch Co.
50-6 Hanover Road, Florham Park, New Jersey
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ASCO

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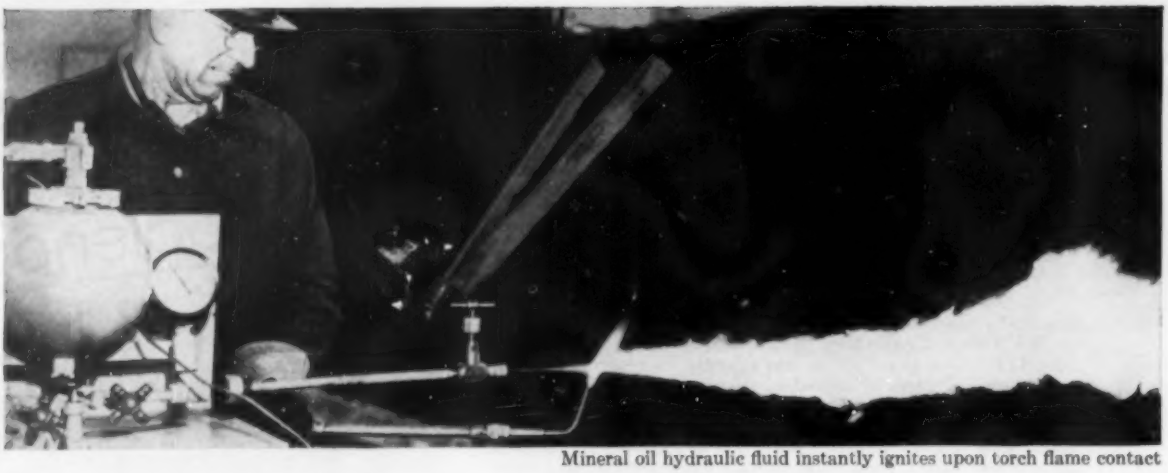


Mineral oil hydraulic fluid instantly ignites upon torch flame contact

Fire resistance plus low cost

FOR MANY YEARS frequent industrial fires involving hydraulic fluids have taken their toll in man-hours and high costs. This has created a widespread need for a relatively inexpensive all-purpose, fire-resistant hydraulic fluid.

In undertaking this challenge, Shell Research Laboratories spent over four years in laboratory and field testing before a solution was reached. The result was the introduction of Irus® Fluid 902 . . . the first low-cost, oil-base fluid that, under plant conditions, actually snuffs out fire.

The new formulation is a specific combination of petroleum oils mixed with water and emulsifying agents. It gains its fire resistance through a relatively high water content. Irus Fluid is perfectly adapted to the majority of hydraulic systems. The following is typical of many reports in Shell files.

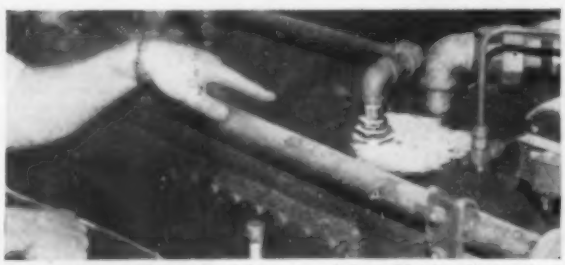
Typical Problem and Solution

The welding plant of a prominent automotive manufacturer employing 100 hydraulically operated electric welders formerly used a straight mineral oil fluid. On one occasion, damaged fluid lines allowed this mineral oil under high pressure to spray directly onto the welding area. Sparks ignited the fluid . . . caused an immediate flash fire which resulted in 75% machinery damage before it was extinguished. Immediately following this incident, the changeover was made to Shell Irus Fluid 902. Shortly thereafter a line broke and the high-pressure spray once more contacted welding sparks. There was no fire at all . . . and in a matter of minutes the machinery was operating at full efficiency.

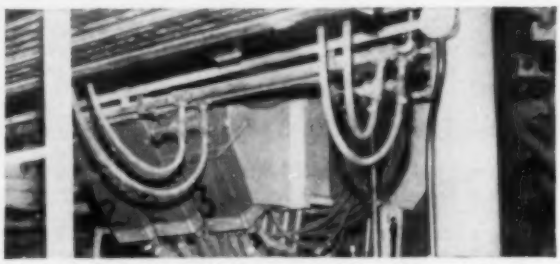
The two photos above provide dramatic proof of its flame resistance. In the photo on the left, conventional hydraulic fluid instantly ignites upon contact with an oxy-acetylene torch flame, whereas Shell Irus Fluid 902 (right photo), under the same conditions, does not support combustion beyond an inch or two from the flame. *Under plant conditions, it actually snuffs out fire!*

Two-Way Economy

An advantage not to be overlooked is the low cost of Irus Fluid 902. Many plant operators now making the



A leak is quickly spotted because of Irus Fluid's distinctive yellow color.



The complexity of cable lines necessitates the use of a fire-resistant hydraulic fluid to eliminate fire hazard.

Under the same conditions, Shell Irus Fluid 902 clearly demonstrates its fire resistance

in a new hydraulic fluid

switch to Irus Fluid find that it costs up to one-third less than other fire-resistant fluids—and its performance is comparable in every practical respect. This money-saving advantage is a vital consideration not only in the initial purchase price, but in reducing make-up loss expense.

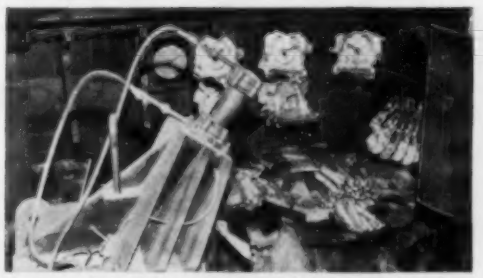
Irus Fluid 902 has other features, too:

1. **It contains no corrosive ingredients and has shown no harmful effects on normal seals, fittings, or bearings . . . it will not promote rust.**
2. **No major equipment modification is necessary . . . simply clean your present fluid thoroughly from the system and replace with Irus Fluid.**
3. **Practical application proves it has exceptional viscosity and lubricating qualities . . . doesn't thin out in use.**
4. **The yellow color of Irus Fluid enables you to spot and trace leaks easily . . . a valuable benefit in preventive maintenance.**

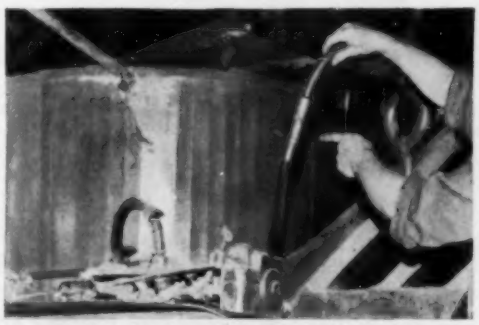
If your operation utilizes die-casting machines, plastic molding machines, glass blowing machines, permanent mold machines or any other hydraulic equipment where fire hazards are of concern, we suggest you investigate the advantages of Shell Irus Fluid 902.

Write or call the Shell Oil Company office nearest you.

*Trademark



Such specialized die-casting machines require a fire-resistant hydraulic fluid to assure maximum safety.



Finger points to line break in hydraulic cable that caused flash fire and machinery damage while operating with mineral oil type fluid.

SHELL OIL COMPANY

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positive, automatic PRESSURE CONTROL
you can depend on

FULFLO piston type, oil-relief hydraulic by-pass valves are designed and built so you can install 'em, then forget 'em! They are quiet, non-chattering because of shear-closing action. Low price and high quality, make Fulflo Valves a wise choice for O.E.M. use . . . replacement too! Available with "O" Ring or Gasket Seal.

- **Standard and Flanged models**
- **Just 6 springs for pressures to 500#**
- **Cast iron or brass bodies**
- **Brass, steel or stainless pistons**
- **Pipe sizes to 2½"**
- **SPECIALS to your requirements**

FULFLO

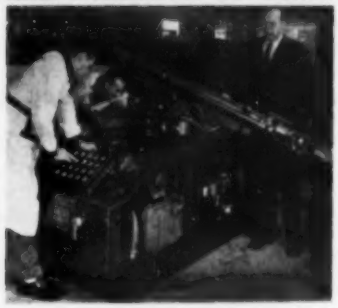
WRITE FOR "Fulflo Valves Mechanical Data Book", free helpful reference.

THE FULFLO SPECIALTIES CO., INC.
415 Fancy Ave., Blanchester, Ohio

BRIEFS continued

Erik's International Trade Fair in Stockholm, Sweden.

- **Control**—Originally, the machine was hydraulically controlled and operated. After three years of development, the unit is still hydraulically operated, but it is now controlled by an electronic sequencing unit. Movements can be determined either manually by an operator, or pre-determined by a set-up on a plug board arrangement in the master control panel.
- **Operation**—Basic, hydraulically powered motions include: grasping device on the horizontal



arm opens and closes and rotates 360 degrees; arm will extend or retract, raise or lower, and rotate 270 degrees in a horizontal plane. Unit is capable of performing a total of 25 individual movements during any one cycle. Sequence and adjustments can be set for an entirely different cycle of operations in minutes.

- **Movements**—All movements are powered hydraulically either by cylinder or hydraulic motor and gear trains from a common hydraulic pump, in conjunction with an accumulator. Hydraulic flow for each movement is controlled by direct-acting, double-solenoid directional valves in conjunction with speed control valves.

Continued on page 52

NOW

for the first time

LOW COMPRESSION SET

Butyl "O" RINGS

NEW

Another LINEAR first . . . a new, low compression-set Butyl Compound for use in "O" Rings. LINEAR Butyl Compound 7806-70 is a seal material that withstands compression set at elevated temperatures without being permanently deformed or losing its resiliency and its value as a seal. Also, Butyl withstands the chemical actions of the non-flammable phosphate esters such as "Skydrol", "Pydraul", "Celluflex" and "Lindol".

YET, PROVEN

Exhaustive tests, under method "B" of the ASTM, show this new LINEAR compound develops only 30 to 40% compression set after 70 hours at 212°F, as compared to the usual 70 to 95% set experienced with previous Butyl compounds. This unusually good resistance to permanent deformation, combined with a tensile strength of 2000 psi and an elongation factor of 275%, make this material an outstanding one for all "O" Ring applications and other molded shapes where Butyl rubber's excellent qualities are desirable.

Whenever you have a seal problem that is tough to handle—look to LINEAR for an answer. Write, or ask the local representative for complete information on LINEAR's new Butyl Compound 7806-70—today.

"PERFECTION IN RUBBER"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA. 35, PA.

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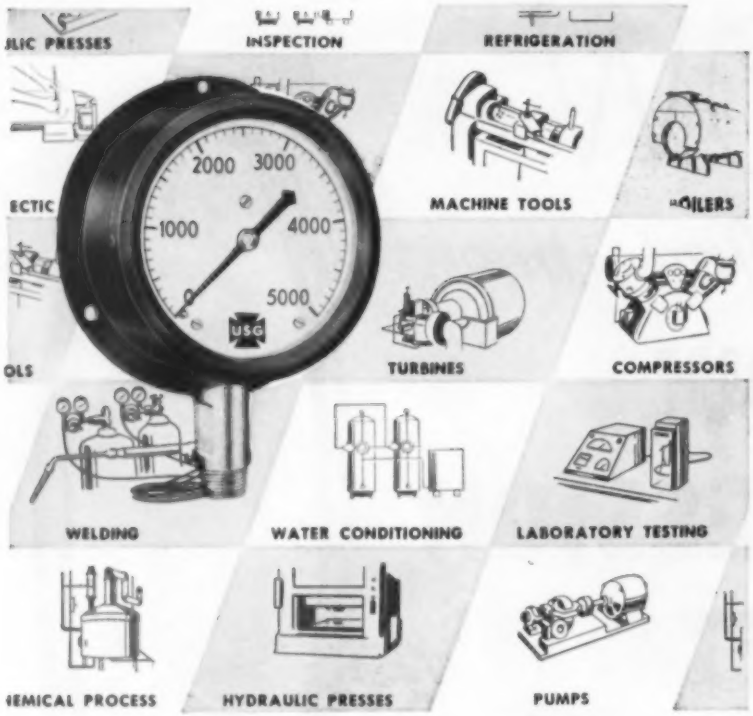

industry buys more USG gauges than any other make

HERE'S WHY

- Practically all industrial gauge requirements can be met by USG.
- For high sustained accuracy . . . for long, trouble-free service under severe temperature and atmospheres . . . there's the Supergauge and Solfrunt Series.
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- Every gauge is backed with more than 50 years experience in gauge construction . . . with research that puts every type of gauge through simulated service conditions for months before it is marketed . . . with quality control that enables USG to guarantee performance in service.
- Buy USG gauges . . . pressure and temperature pilots, recorders and controllers . . . transmitters and thermometers . . . and be assured of guaranteed satisfaction in quality, performance and dependability.

Consult the "Yellow Pages" of your phone book for the name of your USG distributor. Call him or write the factory for catalogs.

Supergauge and Solfrunt Reg. T.M.

USG UNITED STATES GAUGE

Home of the SUPERGAUGE

Division of American Machine and Metals, Inc.
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MORE THAN 50,000 TYPES OF GAUGES • SUPERGAUGES • SOLID FRONT GAUGES • RECEIVER GAUGES • TEST GAUGES • RECORDERS • CONTROLLERS • TRANSMITTERS • PSYCHROMETERS • AVIATION INSTRUMENTS

BRIEFS / continued

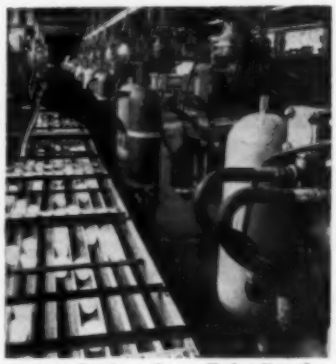
Main turret rotater has double valving system for accelerating and decelerating.

Each movement is measured electrically by a multi-turn or linear potentiometer. Amount of any movement can then be represented or measured by amount of resistance. After initiation of movement, that movement will continue until its resistance matches a preset resistance in a plug board arrangement of the master control panel. When a match or dead band is made, the movement stops. Sequencing is accomplished by means of a variable time stepping switch.

Each movement, such as main swing, tilt, retract, etc., is represented on the master control panel by a row of jack sockets. ▼▼▼

Hydro-Pneumatic Accumulators Speed Production

On automatic injection molding machines, hydro-pneumatic accumulators increase production by providing independent control of a dual injection system on production units. Use of accumulators reduces the overall cycle and gives a more uniform and efficient utilization of the pump. The accumulators are charged by the pump during a period in the cycle when the machine would normally be idling, or dumping the oil back to the reservoir through a relief valve. ▼▼▼



Courtesy Greer Hydraulics, Inc.

Vogt

DROP FORGED STEEL VALVES and FITTINGS

Modern die casting machine operation involves the use of standard hydraulic oils as well as special non-inflammable oils which must be safely and positively controlled at pressures from 800 pounds up to 4000 pounds per square inch.

Vogt drop forged steel valves, fittings, flanges and unions are unsurpassed for these rigorous duties and are standard equipment on the leading makes of die casting machines.

Consult Catalog F-9 for the complete line of Drop Forged Steel Valves, Fittings and Flanges.

"FIRST CHOICE OF THE LEADING MAKERS OF DIE CASTING MACHINES"

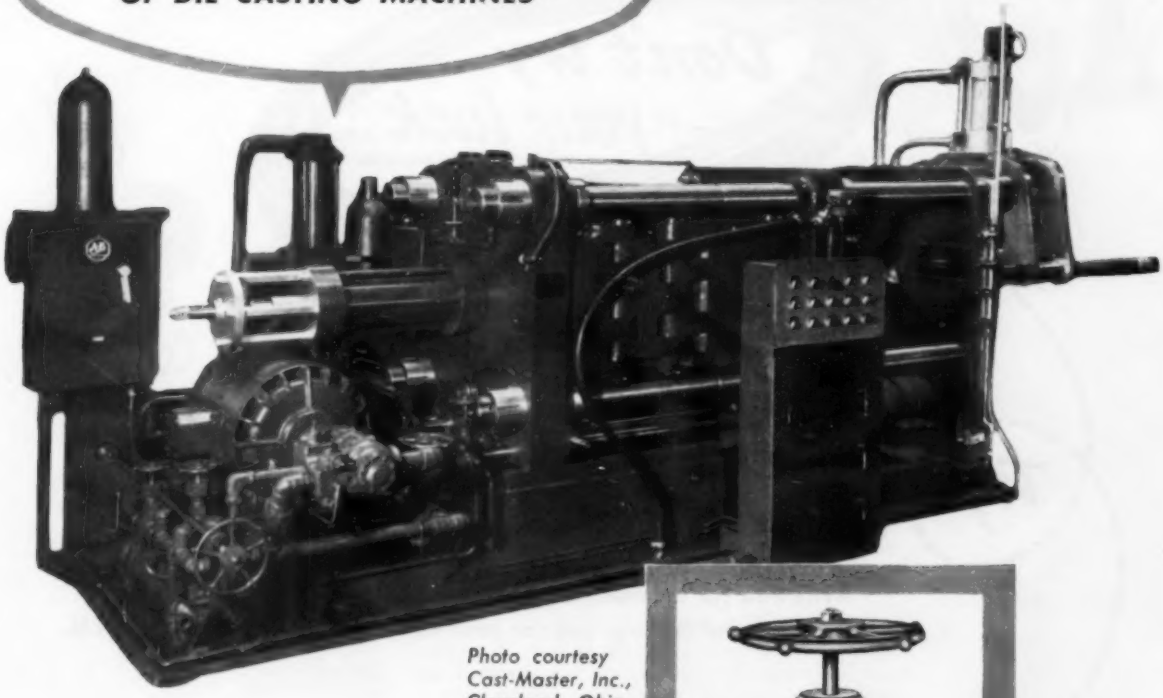


Photo courtesy Cast-Master, Inc., Cleveland, Ohio

HENRY VOGT MACHINE CO.
P.O. Box 1918
Louisville 1, Kentucky

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OTHER VOGT PRODUCTS
Drop Forged Steel Valves, Fittings and Flanges in a complete range of sizes • Petroleum Refinery and Chemical Plant Equipment • Steam Generators • Heat Exchangers • Ice Making & Refrigerating Equipment

try

Don't buy oil seals haphazardly. Get Pioneer Oil Seals.
Pioneer representatives are factory trained men who can deal with any oil-sealing problem on the spot and recommend the seal you need.
Pioneer Personal Oil Sealing Service means not only studying a customer's individual needs; it also means recommending the right oil seals and personal inspection when they are in use.
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PIONEER

Oilsealing & Moulding Co. Ltd.

A DIVISION OF J.H.FENNER & CO. LTD.

Factory & Head Office: Cottontree Works, Colne, Lancashire • England

Circle 102 on Reader Service Card

SIMPLIFY MACHINE DESIGN WITH THIS *Different* AIR CYLINDER

Save design time — save production costs. Eliminate cams, levers, gearing, linkages or other mechanical means for performing push, pull or lift motions. Design with air in mind.

The Bellows Air Motor is a complete electrically-controlled air cylinder power unit with directional valve and speed controls built in. It requires only one air connection which can be made with flexible hose. Compact, space saving, it fits well into crowded quarters or on moving machine elements. It is fast, responds to a starting impulse instantly. It is easily interlocked and synchronized with related machine movements. Its quality and reliability has been proven in more than quarter of a million installations.

The range of work it can do is limited only by the imagination of the design engineer.

Send for this free booklet

Here in these quick reading pages is the full story of The Bellows Air Motor — what it is doing for others, what it can do for you. Address Dept. AH-1057 The Bellows Co., Akron 9, Ohio. Ask for Bulletin BM-25. In Canada, write Bellows Pneumatic Devices of Canada, Ltd., Toronto, Ontario.

765-B

The Bellows Co.
AKRON 9, OHIO

New Products

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

DIFFERENTIAL PRESSURE INDICATOR . . . uses crystal transducer

Designation: SLM DPI-114

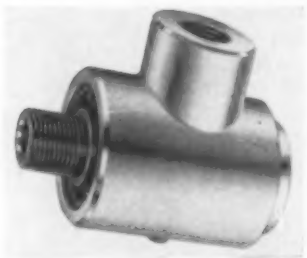
Features: Measures both fast and slow transient differential pressures at any two points in a hydraulic or pneumatic system. Also can be used for short term measurements of difference or sum of steady pressures at any two points.

Specifications: Pickups are independently mounted with their diaphragms flush with the chamber walls. No connecting passage or special plumbing is necessary. Unit measures 0.1 psi change in differential pressure at 3000 psi level. High pressure adaptors extend range to 100,000 psi. Frequency range of pickups is zero to 50,000 cps, and they operate continuously at 600 F.

Kistler Instrument Corp.
North Tonawanda, N. Y.

Circle 180 on Reader Service Card

ROTATING UNION . . . features balanced sealing



Designation: Model 1300

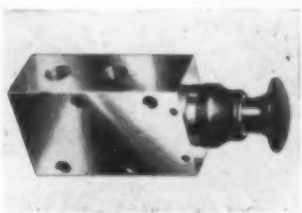
Features: Designed to introduce air or hydraulic oil under pressure into clutches of power equipment, and similar applications. Sealing is done with two micro-lapped end face sealing elements. Sealing washers are easily replaced in the field without special tools. Union features balanced sealing which keeps starting and running torque to a constant minimum. Leakage around the seals is prevented with O-rings. Seals are keyed in position.

Specifications: Operating specs are 1500 rpm, 2000 psi hydraulic and 150 psi air service. Housing is forged aluminum alloy, coil spring is stainless steel, and outrigger bearing is self-lubricating bronze. Available with rotors having ⅜ or ½-in. right hand pipe threads, as well as ⅝-in.—18 N.F. threads.

Deublin Co.
Glenview, Ill.

Circle 181 on Reader Service Card

PILOT AIR CONTROL VALVE . . . has sealed stem



Designation: Flo-Pilot

Features: Valve has a small synthetic rubber boot around the valve stem, sealing all critical parts from dirt and abrasives. Units have been tested millions of cycles and remain leak-free.

Specifications: Basic valve has five optional actuating heads: palm button, ball cam, lever, locking lever, and mechanical link clevis. These are interchangeable in seconds by removing two pins. Replacement spools can also be interchanged without disturbing the piping. Available base, panel, or wall-mounted, the same valve can be used as a two or three-way valve. Built for 150 psi air operation, with ¼-in. pipe ports.

Hanna Engineering Works
Chicago, Ill.

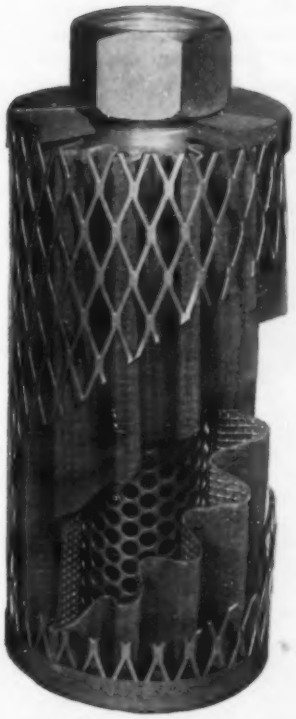
Circle 182 on Reader Service Card

Continued on page 58

MORE AND MORE MANUFACTURERS ARE INSTALLING

MARVEL SYNCLINAL FILTERS

AS STANDARD EQUIPMENT



SUMP TYPE (Cutaway)

Manufacturers of hydraulically actuated equipment and others with low pressure liquid circulating systems demand their equipment to perform consistently and with all the productive efficiency they build into the machine that bears their name. Since these systems must be kept free of damaging particles, the selection of a filter is an important factor. Here are some of the outstanding reasons for the increasing preference for Marvel Synclinal Filters to do this all-important job!

BECAUSE . . . Marvels are designed to give maximum ACTIVE filtering area rather than total filtering area. Only ACTIVE FILTERING AREA COUNTS!

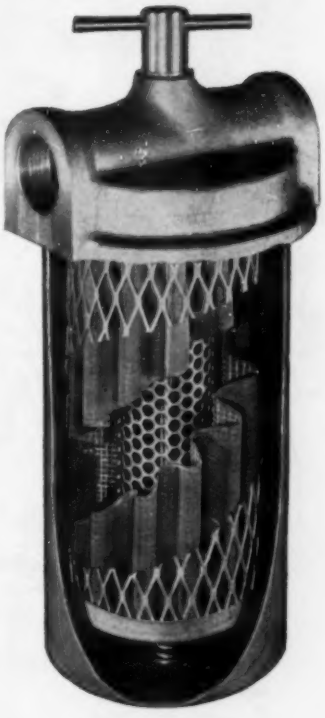
BECAUSE . . . Marvels greater storage space for filtered out particles allows longer periods of "production" time at absolute minimum in maintenance cost and "down-time."

BECAUSE . . . Marvels can be disassembled, cleaned and reassembled by any workman in a matter of minutes. Line type operates in any position and may be serviced without disturbing pipe connection.

BECAUSE . . . Marvels are protected and of sound construction to give long life and efficient filtration. THEY MEET J. I. C. STANDARDS.

BECAUSE . . . Marvels (Both Sump and Line Type) are available in individual capacities from 5 to 100 G.P.M. and choice of mesh sizes ranging from coarse 30 to very fine 200, they get a filter to fit their specific requirements.

BECAUSE . . . Marvel not only delivers a top grade filter in both quality and performance, but delivers IMMEDIATELY—shipments are made the same day orders are received, if desired.



LINE TYPE (Cutaway)

FACTS—NOT CLAIMS

Engineers decide on the basis of the record, on the basis of measurable facts rather than claims of the "campaign promise" variety. Here is a fact with meaning:

OVER 750 MANUFACTURERS MAKE MARVEL SYNCLINAL FILTERS THEIR O.E.M. CHOICE

For Dependable Protection On All Hydraulic And Low Pressure Systems Investigate MARVEL SYNCLINAL FILTERS

Catalogs containing complete data available on request

WATER FILTERS

Both sump and line type filters have been adapted for use in all water filtering applications. No changes have been made in the basic, balanced synclinal design.

FILTERS FOR FIRE-RESISTANT HYDRAULIC FLUIDS

Marvels most recent development is a filter for the efficient filtration of all types of fire-resistant hydraulic fluids.

MARVEL ENGINEERING COMPANY

7227 N. Hamlin Ave., Chicago 45, Ill. PHONE: Juniper 8-6023

Without obligation, please send me complete data on Marvel Synclinal Filters, as indicated: (AH-10)

- ☐ Catalog #108—For Hydraulic Oils, Coolants, Lubricants.
- ☐ Catalog #200—For Fire-resistant Hydraulic Fluids (Aqueous Base)
- ☐ Catalog #400—For Fire-resistant Hydraulic Fluids (Synthetic)
- ☐ Catalog #301—For Water

Name _____ Title _____

Company _____

Address _____

City _____ State _____

Why Use Less Than Chemlon* Packings In Your Hydraulic Cylinders

Hydraulic equipment manufacturers are now taking a *second* look at the many advantages of "John Crane" CHEMLON hydraulic packings and offering them in place of leather, fabric-reinforced and similar packings.

THE REASON . . . CHEMLON provides several very important service advantages.

1. Increased cylinder life due to the inherent non-frictional qualities of CHEMLON.
2. Longer packing service life—CHEMLON outlasts all other types of packing to a remarkable degree . . . decidedly cuts replacement, down time and maintenance.
3. Universal application—CHEMLON'S inertness to all types of hydraulic fluids, including non-flammables and synthetics . . . eliminates the need for customers stocking a wide range of special packings.
4. Trouble-free performance—CHEMLON withstands temperature conditions encountered in hydraulic service up to 350°F.

"John Crane" CHEMLON–*The Best in Teflon*–offers a complete line of piston cup, "U" cup and flange packing for every service requirement.

Get the new bulletin No. P-322 on "John Crane" Hydraulic Packings.

Crane Packing Co., 6405 Oakton St., Morton Grove, Ill. (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

*"John Crane" fabricated from DuPont Teflon

John Crane

MECHANICAL PACKINGS · SHAFT SEALS · TEFLON PRODUCTS · LAPPING MACHINES · THREAD COMPOUNDS

CRANE PACKING COMPANY

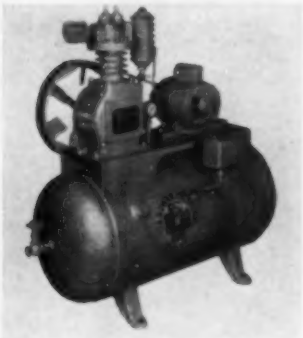
New Products continued

SMALL COMPRESSOR

. . . supplies oil-free air

Designation: Model CACB

Features: Unit is designed to provide oil-free air for operation of instrument controls, industrial processes, and other pneumatic service.



Carbon parts in the cylinder require no oil or water lubrication. Compressor is single-stage, air-cooled, and is available base or tank-mounted. Unit supplies 4 to 5 cu. ft min of oil-free air, and is suitable for discharge pressure of 40 to 100 psi.

Gardner-Denver Co.
Quincy, Ill.

Circle 183 on Reader Service Card

RELIEF VALVE ACTUATOR

. . . is motor-driven

Application: Unit is a light, compact, motorized actuator for direct mounting on a relief valve to provide greater ease and accuracy of setting than can be done by hand

adjustment, and provide this remotely.

Specifications: Unit weighs 1¾ lbs, and can be furnished with two-speed control. Limit switches are included for normal open and closed settings. These limits may be set for two pre-selected pressure settings within the range of the re-

Continued on page 60

ALEMITE

SURGEPRUF

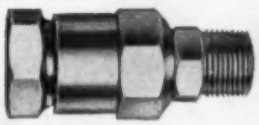
reusable couplings and hydraulic hose

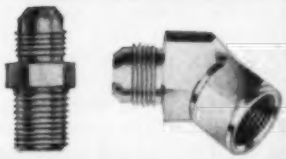
- *for fastest in-the-field replacement!*
- *first choice for original equipment!*

Single and Double Wire Hose For Medium-High Pressure and High-Pressure Service

Seamless inner tube of synthetic rubber, reinforced steel wire braid, and synthetic rubber outer cover. Resists abrasion, weather, and oil. Hose temperature operating range: —40°F. to +275°F.

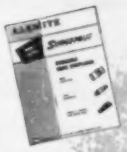
Couplings. Made of high-strength steel. "Double-wedge grip" forces coupling threads through rubber cover . . . grips either single or double wire braid firmly. Saves both time and labor!





Adapters. Full range of sizes in J.I.C. and other threads. One-piece adapters—and swivel union adapters to simplify assembly and avoid twisting strain in cramped quarters.

Hose Assemblies. Types and sizes for all hydraulic lines. No special assembly tools required. Fast, easy assembly with just ordinary tools!



Write For Free Catalog!

ALEMITE

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Division of STEWART-WARNER CORPORATION

STEWART SW WARNER

Alemite, Dept. EE-107
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Chicago 14, Illinois

Please send me my free copy of the complete Surgepruf Catalog.

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Company_____

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MARSH impregnated leather Packing Leads Again!

MARSH BEST SINCE 1900 LEATHER PACKINGS

New MARSH development will increase the life, efficiency and prestige of your product!

Our research division—pioneers in the development and improvement of impregnated mechanical leathers—offers you a new, tougher—wear, age and extreme temperature resistant—impregnated mechanical leather packing, possessing remarkable resilience and flexibility.

ENGINEERING AND CONSULTING SERVICE

If you seal oil, water, air, vacuum, gas, gasoline, naphtha, alcohol or other fluids, ask Marsh for field engineering service.

FEATURES: Low coefficient of friction—both static and running, greater wear resistance, tighter sealing, better high and low temperature stability, improved lubrication potentials, longer life.

• Write for Engineering Handbook and technical literature.

C. W. MARSH COMPANY

Main Office and Factory . . . Muskegon, Michigan

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75 E. WACKER DRIVE	101 PARK AVE., ROOM 1730	1900 EUCLID AVENUE
CHICAGO 1, ILLINOIS	NEW YORK 17, NEW YORK	CLEVELAND 15, OHIO

New Products / continued

lief valve. A wide range of actuator speeds is available to provide any desired time for full stroke actuation. Standard motor voltage is 28V d.c. Other voltages can be used by changes in the motor or control box.

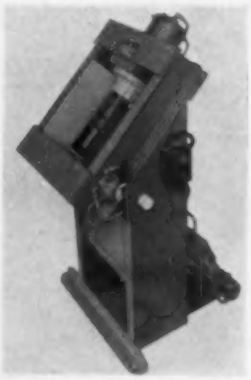
United Hydraulics, Inc.
Dayton, Ohio

Circle 184 on Reader Service Card

SWAGING MACHINE

. . . offers easy operation

Designation: WH 51 & 53
Features: Machine is designed with the swaging unit positioned at a 45° angle, permitting the operator to remain in a normal, upright position while setting up and con-



trolling the swaging operation.
Specifications: Unit is compact, with controls, gages and work center all on the same visual plane. It requires less installation space and less piping; gives easier access to pump and reservoir, and lowers the center of gravity for strength and stability. Available in two models: WH 51 HMD high speed, single phase, for 110/220 volt circuit, 60 cycle; and WH 53 HMD high speed, three phase, for 220/440 volt, 60 cycle.

Weatherhead Company
Fort Wayne, Ind.

Circle 185 on Reader Service Card

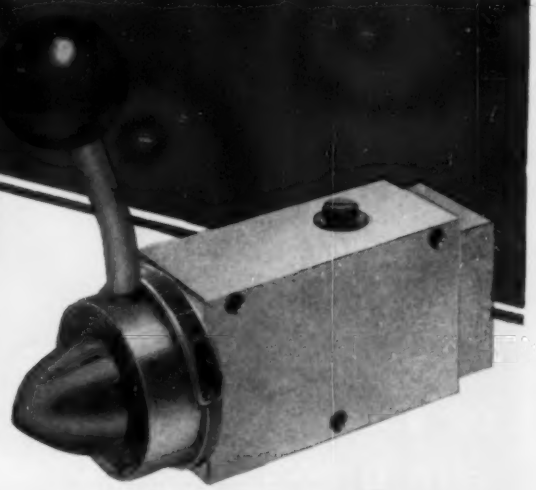
5000 PSI THROTTLING VALVE

. . . has low turning torque

Designation: 155-16D
Design: Valve overcomes disadvantages of restricted flow, high pressure drop, and high handle turning

Continued on page 62

For SAFE, DEPENDABLE ENGINEERED for DURABILITY . . . CONTROLS



CONSULT WATERMAN

Waterman controls are known for their accuracy, dependability, safety, and low maintenance cost.

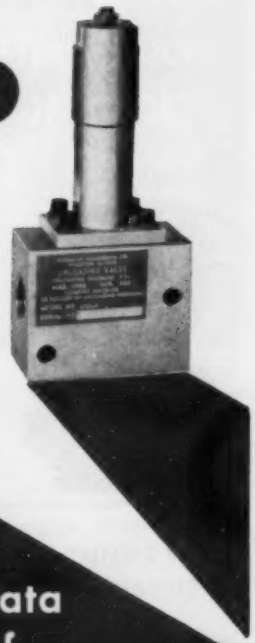
Adjustable Flow Regulators range from 0.5 GPM to 20 GPM. They maintain a constant rate of flow regardless of resistance or pressure fluctuations.

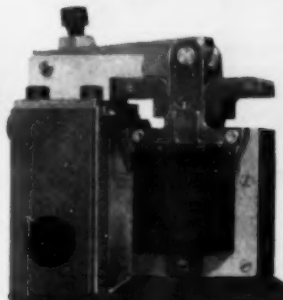
No. 1. Check Valves are one piece, Nylon Poppet, aluminum body and low pressure drop.

No. 2. Micronic Line Filters have operating pressures to 3000 psi, 40 micron filtration, replaceable elements, and are available in ⅜" and ¾" NPT.

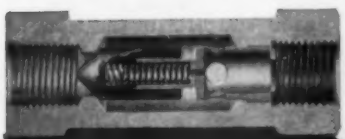
No. 3. Solenoid Valves are inexpensive compactly built units for hydraulic systems handling non-corrosive fluids. Capable of continuous operation for working pressure to 3000 psi.

No. 4. Unloading Valves for pressures to 3000 psi. Flow rates to 30 GPM. Fast acting, maintain desired pressure without continuous readjustments.





1 Send for Bulletin A

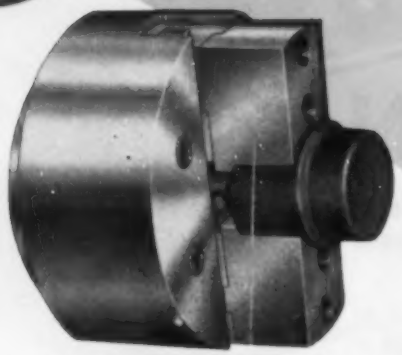


Write for data on any of these WATERMAN products

WATERMAN ENGINEERING COMPANY

725 CUSTER AVENUE EVANSTON, ILLINOIS

POWER CHUCKS



for more gripping power– higher production

Famous S-P cam and lever design holds the work tighter, permits cost cutting heavy feeds and multiple cuts. S-P cam and lever design also resists opening of jaws by centrifugal force or diminishing air pressure . . . an important safety factor. Balanced for high rpm.

S-P SELF-CENTERING CHUCKS are built in Universal American Standard models, sizes 6" – 8" – 10" – 12", and Serrated models in 8" – 10" – 12" sizes. Two or three jaws.

S-P COMPENSATING CHUCKS grip out-of-round work with equal pressure on each jaw. Available in 8" – 10" – 12" sizes, two and three jaw models, American Standard or Serrated.

S-P ROTATING CYLINDERS

Air and Hydraulic

Adequate stroke for long jaw travel of S-P Chucks. Balanced for high rpm on machine tools and other applications. Details in Catalog No. 105 (Air) and Bul. 201 (Hydraulic).

S-P Power Chucks are installed as original equipment by Bardons & Oliver, Cleveland Automatic, Cone Automatic, Ex-Cell-O, Jones & Lamson, Monarch, Warner & Swasey . . . and many others. Representatives in principal cities. Prompt deliveries. Send for catalog No. 105. The S-P Manufacturing Corporation, 30201 Aurora Rd., Solon, Ohio.

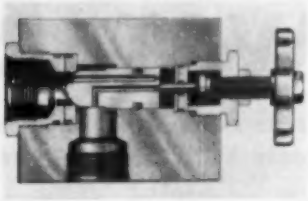
SPecify SP

THE S-P MANUFACTURING CORP.
SOLON, OHIO • IN GREATER CLEVELAND
ESTABLISHED 1916 A BASSETT COMPANY

NON-ROTATING AIR AND HYDRAULIC CYLINDERS • ROTATING AIR AND HYDRAULIC CYLINDERS
POWER CHUCKS • COLLET AND DRILL PRESS CHUCKS • AIR PISTONS, VALVES, ACCESSORIES

New Products / continued

torque by means of pilot needle valve control of a large dynamically balanced piston. All flow regulation is through the pilot valve, which can be turned easily because of the small area under pressure and the large, fine-pitch thread. Full flow is obtained by only 2½ turns



of the pilot valve, yet metering is accurate to 1/100 gpm through entire range of the valve.

Specifications: Aluminum alloy body, with stem, inserted seat, and piston of hardened, stainless steel. Standard with AND 10050-16 O-ring seal, internal straight thread connections.

Republic Mfg. Co.
Cleveland, Ohio

Circle 186 on Reader Service Card

NYLON PRESSURE TUBING . . . for 1000 and 2500 psi

Features: Tubing is designed for pressure lines, including hydraulic and pneumatic service. Some of its advantages are: high-pressure rating at low cost; extremely high flex and vibration life; low minimum bend radius; abrasion and crush resistance; inertness to hydrocarbons, oils, greases, synthetic hydraulic fluids.

Specifications: Available in diameters from ⅛ to ½-in. OD in two types—for 1000 and 2500 psi. Tubing is adaptable to standard flare and flareless fittings, easily installed, requires no pre-bending, flexible couplings, or intermediate fittings, and has a wide service-temperature range.

United States Gasket Co.
Plastics Division
Garlock Packing Co.

Circle 187 on Reader Service Card

For more NEW PRODUCT reviews turn to page 164

Decco OIL-IMMERSED SOLENOIDS

give incredible performance

INSTALL THEM AND FORGET THEM. TESTS SHOW NO APPRECIABLE WEAR AFTER MILLIONS OF STROKES.

Here's why:

SEALED IN OIL. Each unit is sealed in its own, contamination proof, oil filled, die-cast housing. A convenient, plug-in base allows split-second replacement in case of change in power requirements. Heat dissipation and wear control reach a new level of efficiency in these units.

SHOCK MOUNTED. Only DECCO can give you service-proved, two direction shock-mounting—a valuable bonus in the service-life of your solenoids.

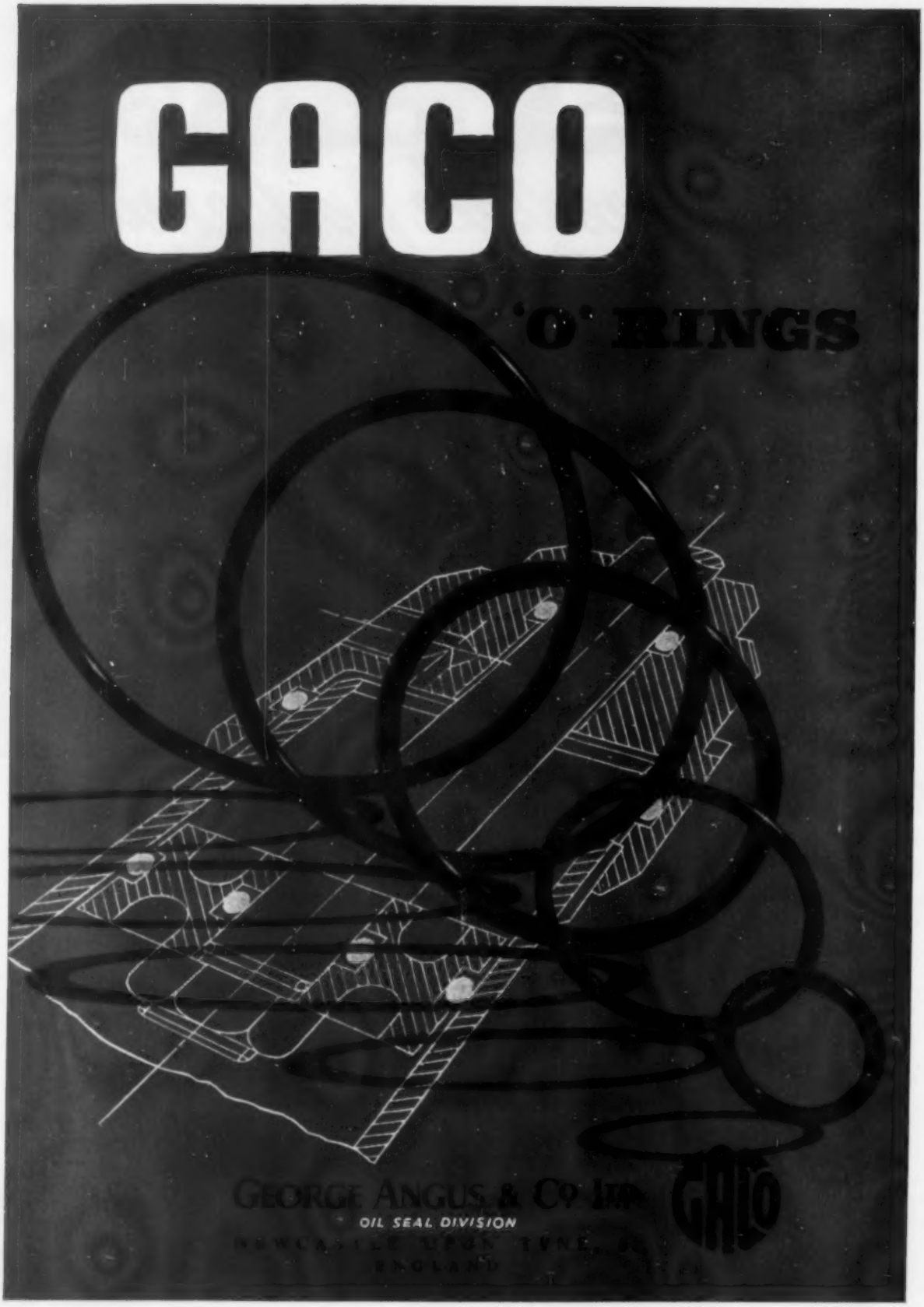
BETTER ENGINEERING. Minimum power loss. 30° to 50° cooler operation. Tremendously greater service-life.

DECCO Solenoids are made in a complete range of types, sizes and mountings. AC or DC. SPECIAL SOLENOIDS will be engineered on request.

Decco SOLENOIDS THE HEART OF DEPENDABLE AUTOMATION EQUIPMENT

DETROIT COIL COMPANY

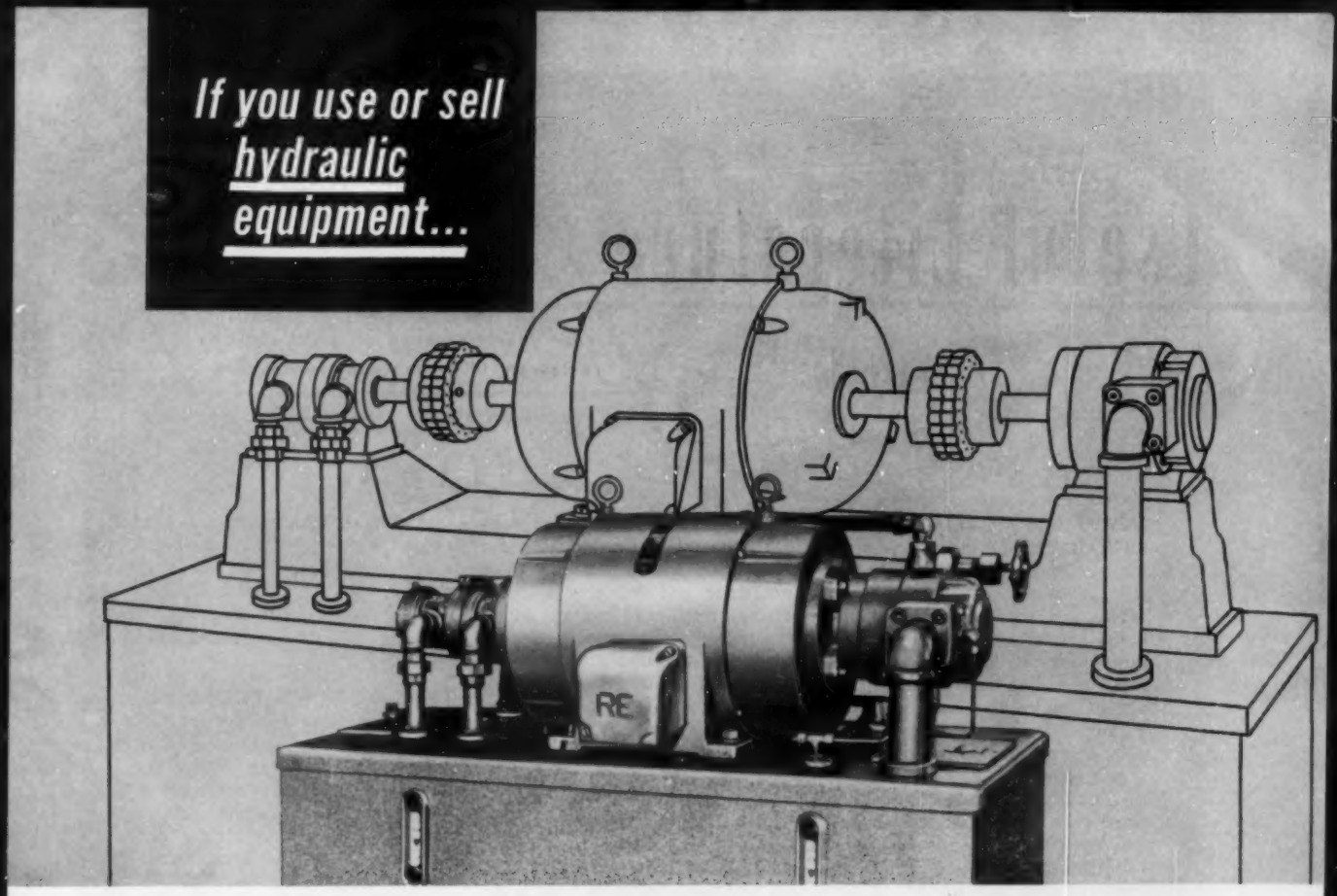
2435 HILTON ROAD, FERNDALE 20, MICHIGAN



Circle 10 on Reader Service Card

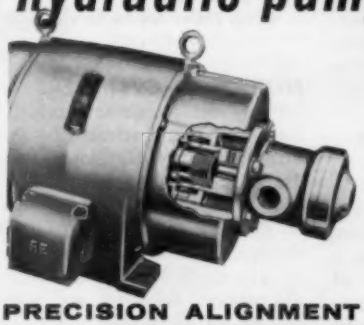
Circle 111

If you use or sell hydraulic equipment...



...cut space needs almost 50% with REULAND spline-coupled hydraulic pump mount motors!

Pump and motor become *one* with the new Reuland spline-coupled hydraulic pump hook-up. The pump shaft is connected directly to the motor's shaft *inside the motor.* Flexible couplings are eliminated... pump mount platforms are eliminated... and the tank length can be reduced because almost 50% less mounting area is required. Compact appearance is beautiful.



SPEEDY INSTALLATION

Pump-to-motor hook-up is merely a matter of seconds. All you do is slip the spline coupling onto the pump shaft...and attach the pump to the endbell. This spline coupling is supplied with the motor and is precision mated for each make of pump. There's no time wasted tinkering around... takes only a fraction of the ordinary time.

PRECISION ALIGNMENT

Alignment is perfect *automatically* whether the installation is made out in the field or on the production line. This permits even unskilled workmen to handle this simple task without error. Also, by hooking the pump up at the point of bearing support, within the motor, vibration is reduced to a new minimum. Operation is smooth, quiet.

COSTS LESS...SAVES INSTALLATION LABOR... FITS ALL PUMPS

The Reuland spline-coupled unit is priced lower than a conventional set-up... saves you extra money by reducing installation costs. What's more, we can supply it to fit any make of pump you may be using. So sure are we that it will be of help to you, we are offering to engineer a demonstration unit to *your* equipment, without the slightest obligation. These units are our best salesmen.

OUR NEW GENERAL CATALOG WILL COME IN HANDY–SENT FREE ON REQUEST.

MODERN POWER FOR MODERN-DAY PRODUCTS

REULAND MOTORS

REULAND ELECTRIC COMPANY
WESTERN DIVISION: Alhambra, California
EASTERN DIVISION: Howell, Michigan
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Useful Literature

For your free copy of publications reviewed, fill in the reader service card

HEAVY DUTY CYLINDERS . . . for hydraulic and pneumatic service, are illustrated and described in 30-page catalog issued by Lincoln Machine Co., Inc., Salem, Ohio. Units are designed for use in steel mill operations and other applications requiring heavy duty cylinders. Complete engineering information is given on all types available, and the catalog includes valuable reference data, such as tables of areas of circles, displacement and force chart for hydraulic cylinders, and computation charts for figuring displacement, pump delivery, velocity, time and force.

Circle 230 on Reader Service Card

CYLINDER-FINISH TUBING . . . for cylinders and other fluid power applications requiring smooth, close tolerance ID, is described in Technical Bulletin R7A issued by Tube Reducing Corporation, Wallington, N. J. Folder gives performance data and application facts and describes the "Rockrite" forming process.

Circle 231 on Reader Service Card

VALVES & CYLINDERS . . . Available from Rivett, Inc., Boston, are illustrated and described in a folder featuring cross-sections of a valve and a cylinder, for hydraulic service. Brochure shows mounting styles and connections, such as pipe, flange, or sub-plate mounted.

Circle 232 on Reader Service Card

SOLENOID VALVE CATALOG . . . 114 pages, with 8 indexed sections is available from Automatic Switch Co., Florham Park, N. J. Indexed sections of Catalog No. 25 cover engineering information, with ilustrations, CV flow factors for valve sizing and flow nomographs; two, three and four-way solenoid valves, manual reset two and three-way valves; corrosion resistant valves and selection guide; special purpose valves and accessories; special valves, such as for nuclear reactors, guided missiles, etc. Catalog contains construction details, flow diagrams, cross section views.

Circle 233 on Reader Service Card

HYDRAULIC EQUIPMENT . . . for 1000 to 3000 psi service is described in 12-page Brochure BL-757, issued by Benjamin Lassman & Son, Glenshaw, Pa. Valves,, cylinders, pump units, presses and special control systems are covered. Brochure gives application illustrations, and describes method of designing equipment.

Circle 234 on Reader Service Card

MINIATURE CYLINDERS . . . for air and hydraulic service, are listed in bulletin released by Pneumatic-Hydraulic Development Co., Tom Thumb Div., Fort Wayne, Ind. Units are designed for service at 200 psi air, and 2000 psi hydraulic. Bore sizes range from ¾ to 1⅛-in. Folder gives complete dimensional drawings and specifications for all models.

Circle 235 on Reader Service Card

AIR COMPRESSORS . . . complete line of units manufactured by Binks Mfg. Co., Chicago, is illustrated and described in their Catalog 820. Complete technical information is given on various models, including tank-mounted, vertical tank-mounted, single and two-stage, air and water-cooled, base-mounted, and portable units. Included are some valuable points on how to select the proper compressor.

Circle 236 on Reader Service Card

TUBE WORKING TOOLS . . . manufactured by Weatherhead Co., Fort Wayne Div., are covered in 8-page Catalog 6111. Items described include tools for flaring, burnishing, double-flaring, cutting, bending and joining copper and JIC steel tubing. Complete instructions are included for each tool. Of special interest is the rotary-type

flaring tool—a one-piece flaring tool with rotary-type clamping dies for dial-matic tube size selection and an automatic tube height gage permitting positive flare diameter control.

Circle 237 on Reader Service Card

O-RING HANDBOOK . . . gives very complete information on the design and application of synthetic

Continued on page 68

*Snap-Tite

QUICK-CONNECT

QUICK-DISCONNECT COUPLINGS

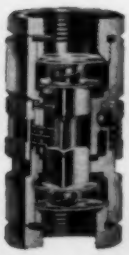
in larger sizes

immediate delivery

FROM FACTORY STOCKS

SNAP-TITE'S "H" COUPLING, SIZE FOR SIZE, IS THE SMALLEST COUPLING WITH HIGHEST STRENGTH AND HIGHER EFFICIENCY

Snap-Tite's "H" Couplings are now factory-stocked for quick shipment to you, not only in the smaller sizes (below 1" ID) but in all sizes up to and including 3"—in steel, brass, aluminum, and 303 and 316 Stainless Steel. And "H" Couplings can be made to your order, up to 10" ID.



Available with valves to give two-way or one-way automatic line shut-off, or without valves for straight-thru flow, "H" Couplings are built to handle high pressures in hydraulic and air systems.

Recessed valve washers . . . fluted valve stems . . . valve stops with minimum flow restrictions . . . large inside diameter—allow maximum flow capacity with lowest pressure drop.

See the Snap-Tite representative in your city or write for Bulletin 240.

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UNION CITY 1, PENNSYLVANIA

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS

Up to 10,000 psi,
6,000 psi continuous

No. 798-AC Power Pump with ¾-hp, 115-230-volt a-c electric motor

TWO SPEEDS FOR FAST RAM APPROACH!

GREENLEE NO. 798 Portable Power Pumps eliminate nearly all the time loss accumulating while operators of hydraulic devices wait for the ram to contact the work! If you specify pumps for hydraulic rams, jacks, presses, or other systems, be sure to learn the details of this *exclusive* advantage and numerous other advance features of GREENLEE No. 798 Power Pumps capable of developing continuous pressure of 6,000 psi and up to 10,000 psi intermittent pressure. Delivery rate at 1,000 psi, 36 cubic inches per minute; at 10,000 psi, 28 cubic inches. Available with 115-230-volt a-c or 115-volt ac-dc motor; also with gasoline engine. All deliver fast dependable hydraulic power with superior efficiency.

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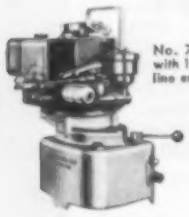

No. 798-GM—with 1.7-hp gasoline engine

No. 798-CO—with ½-hp, 115-volt ac-dc universal electric motor

No. 797-E—with choice of 2-hp or 3-hp a-c electric motor, delivering 106 or 213 cu in. of oil per min. Also available with gasoline engine.

TOOLS FOR CRAFTSMEN
GREENLEE

WRITE, or simply attach this page to your letterhead, for illustrated data sheets giving applications, features, and specifications of GREENLEE No. 798 Pumps.

GREENLEE TOOL CO., 2450 HERBERT AVE., ROCKFORD, ILLINOIS, U.S.A.

Useful Literature / continued

rubber O-ring seals. Catalog 5700, published by Parker Appliance Co., Cleveland, should prove useful to designers and engineers working on problems of sealing in industrial and military applications. It consists of 160 pages, with illustrations, charts and other valuable data. Divided into nine sections, the book covers O-ring applications, compounds and how to select them, engineering data, gland design, installation, static and dynamic seals, military and industrial requirements, and O-ring sizes.

Circle 238 on Reader Service Card

BEARINGS & ROD ENDS . . . for fluid power applications, are covered in Bulletin 257, released by Sealmaster Bearing Div., Stephens-Adamson Mfg. Co., Aurora, Ill. Bulletin lists feature and gives engineering data on the line of spherical bearings and rod ends available.

Circle 240 on Reader Service Card

RESISTANCE WELDED TUBING . . . Production and design engineers will be interested in an eight-page folder TB-419 published by the Tubular Products Div., Babcock & Wilcox Co. This bulletin explains the advantages offered by the use of electric resistance welded mechanical tubing. It also supplies detailed information on the mechanical properties and lists the various size tolerances normally produced.

Circle 241 on Reader Service Card

SYNTHETIC SEALING RING . . . produced by Parker Appliance Co. Cleveland, is described in Catalog 5701. The new synthetic rubber sealing ring, called "Wingseal" from its cross-section shape, is interchangeable with AN 6290 O-ring sizes on AND 10056 fittings in the AND 10050 boss. New design has been evaluated in a two-part test, one using maximum seals in minimum bosses, and the other minimum seals in maximum bosses. Hydraulic impulsing, using OS-45 fluid, was at 40 cycles per minute,

Continued on page 70

Circle 52 on Reader Service Card

Circle 140 ⟶

more motor
than ever before

1 TO 50 H. P.

THE REVOLUTIONARY TYPE H

U. S. UNICLOSED

more motor dependability is the result of more and more exclusive features: Asbestos insulation against heat and moisture; Lubriflush bearing construction for longer life; Ventrifoil baffles to direct air, deflect moisture; rugged, normalized cast iron frame . . . all Uniclosed Type H features for longer motor life, more efficient power. Write for profusely illustrated multicolor bulletin today.

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more LIFE

Lubriflush replaces old grease with new, for longer bearing life. Other life-lengthening features of Uniclosed are explained below.

more RUGGED

Cast-iron frame defies distortion. The smooth cast-iron surface is highly corrosion-resistant. Heavy solid feet are a substantial part of the frame.

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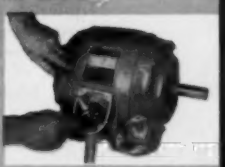
Ventrifoil directs air, deflects water. Each end of motor has specially formed deflector that directs air around bearing housings, into fans on rotor.

more INSULATION

U. S. multiple protection increases insulation life. ASBESTOS — for protection against heat. POLYESTER FILM—for greater physical strength.

more CONVENIENT

The spacious conduit box on Uniclosed Type H is heavy-duty cast-iron, diagonally split type, attractively contoured —easy of access.



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AH-10

☐ *Send Uniclosed Type H Bulletin No. F-1856*

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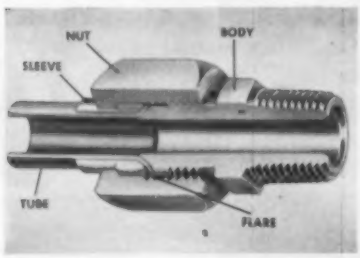
New Parker No-Skive Hoze-lok

FASTER . . . EASIER . . . RE-USABLE

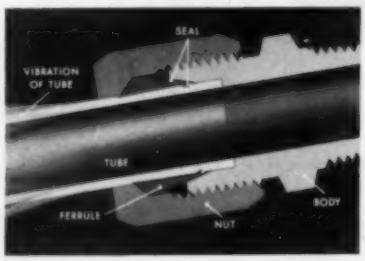
No more frustrating jobs of stripping covers from hydraulic wire-braid, rubber-covered hose! No more ragged hose ends refusing to enter sockets!

New Parker Hoze-lok Fittings save you all this time and trouble. Skiving of hose covers is *not* necessary. Simply screw the nipple in to complete the make-up. What could be easier . . . or more effective?

Versatile Hoze-lok Fittings are re-usable . . . an important benefit to users of your equipment. Select your Hoze-lok Fittings now from the new, wide range of styles and sizes, with four different connecting ends and full range of adapters. Send for Catalogs 4433, 4434.



Triple-lok Flare Fittings . . . the easiest, fastest, safest way to tube up even in close quarters. Leakproof even under severe vibration, high pressures. Meet S.A.E. Standard. Catalog No. 4310.



Ferulok Flareless Fittings for high-pressure heavy-wall tubing. Double seal makes Ferulok leakproof, vibration-proof. You can see the "bite." Meet S.A.E. Flareless Standard. Catalog No. 4320.

TUBE AND HOSE FITTINGS DIVISION
Section 431-B
The Parker Appliance Co.
17325 Euclid Avenue
Cleveland 12, Ohio

Parker
Hydraulic and fluid system components

Useful Literature / continued

400 F, 3000 psi, rate of rise 175, 000 psi per second.

Circle 242 on Reader Service Card

SEAMLESS TUBING GUIDE . . . Engineers associated with the design, fabrication, or production of equipment involving the use of hollow, cylindrical parts, will benefit from information furnished in Bulletin TB-340A, published by Tubular Products Div., Babcock & Wilcox Co., Beaver Falls Pa. This 8-page folder explains the cost and time-saving benefits of tubing over other forms of stock. Included are descriptions of how seamless tubing is manufactured and finished, and the differences in dimensional tolerances, costs, machinability and surface finishes of various types of seamless mechanical tubing.

Circle 243 on Reader Service Card

THIN TEFLON SECTIONS . . . new brochure published by Sparta Mfg. Co., Dover, Ohio, covers their patented process of custom molding parts of Teflon in thin sections and shapes. Brochure covers the properties and characteristics of Teflon, suggested end uses, and illustrations of many parts designed by this method, such as cup, ball or shaft seals, washers, gaskets, and diaphrams.

Circle 244 on Reader Service Card

FLEXIBLE CUSHION COUPLING . . . is described in 12-page Bulletin A669 released by Dodge Mfg. Corp., Mishawaka, Ind. Full page of general information explains how by means of rubber tire element the coupling accommodates angular misalignment, parallel misalignment, and end float; singly or in any combination; besides cushioning shock loads and diminishing torsional vibration. Full view and cutaway photographs are included along with drawings to illustrate construction and installation features. Several pages are devoted to tables with engineering data to facilitate selection of couplings for many applications.

Circle 245 on Reader Service Card

For more reviews of FREE LITERATURE turn to page 172

Don't buy O-rings blindly!

Prove by comparison tests that Parker O-rings seal better, last longer

Comparison tests will show you that Parker O-rings are better. You can't *see* the difference. You can't *feel* the difference. But in *use*, Parker O-rings actually do seal better and last longer!

Why? Because Parker O-rings are precision-molded of superior compounds developed by exhaustive research and experimentation. Our engineering service will help you with your particular problems — whether in gland design or compound. From Parker, you get the *right* O-ring for your *specific* application. Compare Parker O-rings and discover the difference for yourself.

These trouble-free, leakproof seals are carefully evaluated for elongation, tensile strength, compression set ratings, resistance to oils, fuels, chemicals and temperature extremes. Exacting laboratory and service tests make sure that Parker O-rings meet applicable specifications. Whatever your requirements, Parker can supply the O-rings you need.

Ask your Parker O-ring distributor today for new O-ring Size Catalog or mail the coupon for your copy.

Parker

Hydraulic and fluid system components

Parker O-Lube is especially formulated for O-ring lubrication requirements. It comes in a handy, squeeze-tube container.

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The Parker Appliance Company,
17325 Euclid Avenue, Cleveland 12, Ohio.
1538 South Eastern Ave., Los Angeles Cal.

Please send:

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- ☐ O-Lube Catalog No. 5840

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Circle 99 on Reader Service Card

New Parker No-Skive Hoze-lok

FASTER . . . EASIER . . . RE-USABLE

No more frustrating jobs of stripping covers from hydraulic wire-braid, rubber-covered hose! No more ragged hose ends refusing to enter sockets!

New Parker Hoze-lok Fittings save you all this time and trouble. Skiving of hose covers is *not* necessary. Simply screw the nipple in to complete the make-up. What could be easier . . . or more effective?

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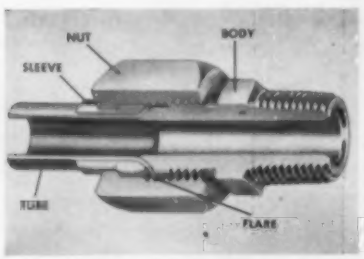

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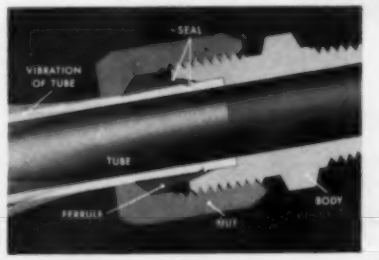

Ferulok Flareless Fittings for high-pressure heavy-wall tubing. Double seal makes Ferulok leakproof, vibration-proof. You can see the "bite." Meet S.A.E. Flareless Standard. Catalog No. 4320.

TUBE AND HOSE FITTINGS DIVISION
Section 431-B
The Parker Appliance Co.
17325 Euclid Avenue
Cleveland 12, Ohio

Parker
Hydraulic and fluid system components

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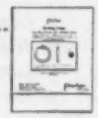
These trouble-free, leakproof seals are carefully evaluated for elongation, tensile strength, compression set ratings, resistance to oils, fuels, chemicals and temperature extremes. Exacting laboratory and service tests make sure that Parker O-rings meet applicable specifications. Whatever your requirements, Parker can supply the O-rings you need.

Ask your Parker O-ring distributor today for new O-ring Size Catalog or mail the coupon for your copy.

Parker O-Lube is especially formulated for O-ring lubrication requirements. It comes in a handy, squeeze-tube container.



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Parker

Hydraulic and fluid system components

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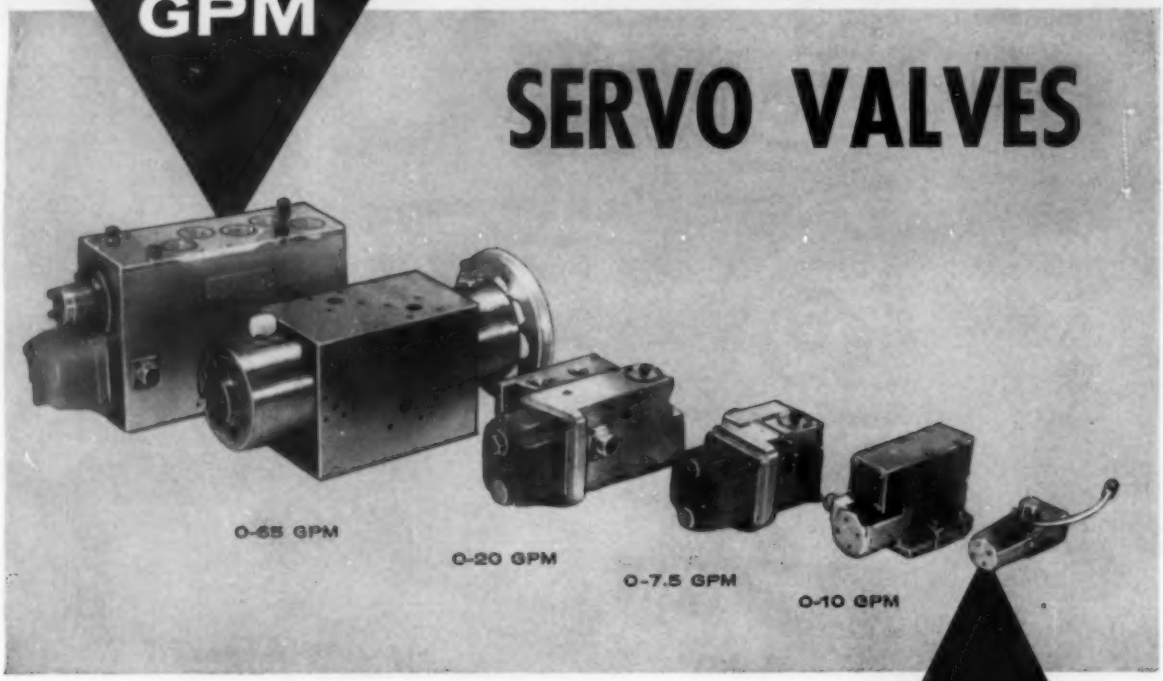
0-175 GPM

SANDERS Electro-hydraulic

SERVO VALVES



0-5 GPM

Industry's smallest valve.
Dim.: 1.1" x 1.1" x 3.9"

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Among the most important operational advantages built into Sanders servo valves is adaptability. The standard models shown here are being used successfully in industrial, marine, and aeronautical applications of an ever-increasing variety. Their flow capacities range from 5 to 175 GPM at 1000 psi. across the valve, and 3000 psi. supply pressure. Valves with higher flow capacity can be produced to specification.

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In addition to servo-valve diversification, Sanders' proven production ability is backed by extensive manufacturing facilities, precision equipment and skilled personnel.

Sanders electro-hydraulic servo valves feature . . .

- **Low resolution**
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Want the detailed story? Write today for complete information. If you prefer, ask to have a Sanders Application Engineer call for consultation. No obligation, of course.

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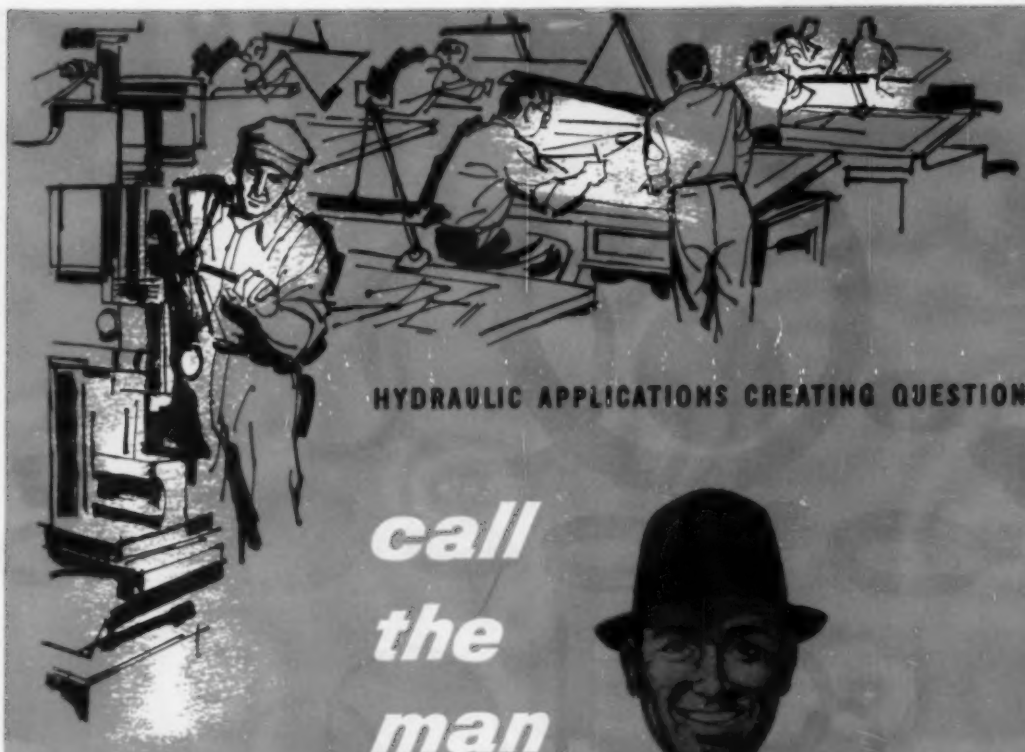

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call the man from Webster

Evaluating hydraulic systems? Balancing pressures and flows against costs? Then, the man from Webster can help you. Today, when you are caught between price and performance, his technical help slanted in a fresh direction, can be the push that gets you into the clear. Call the man from Webster whenever you require hydraulic pump help for lubricating, oil circulating, filtering, transfer or quiet hydraulic power applications. He's a good man to have on your design team.

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MELROSE 3-3511
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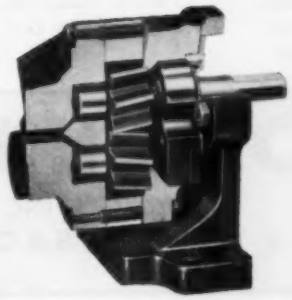
OVER 100 MODELS

Capacities: *1/5 to 30 GPM*
Pressures: *Up to 1500 PSI*
Speeds: *Up to 3600 RPM*
Drives: *Direct or Geared*
Torques: *Up to 60 in. lbs./100 PSI*
Available with or without built-in relief valves



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☐ *Complete hydraulic catalog of pumps and valves*

☐ *New information or data as published*

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Company _____
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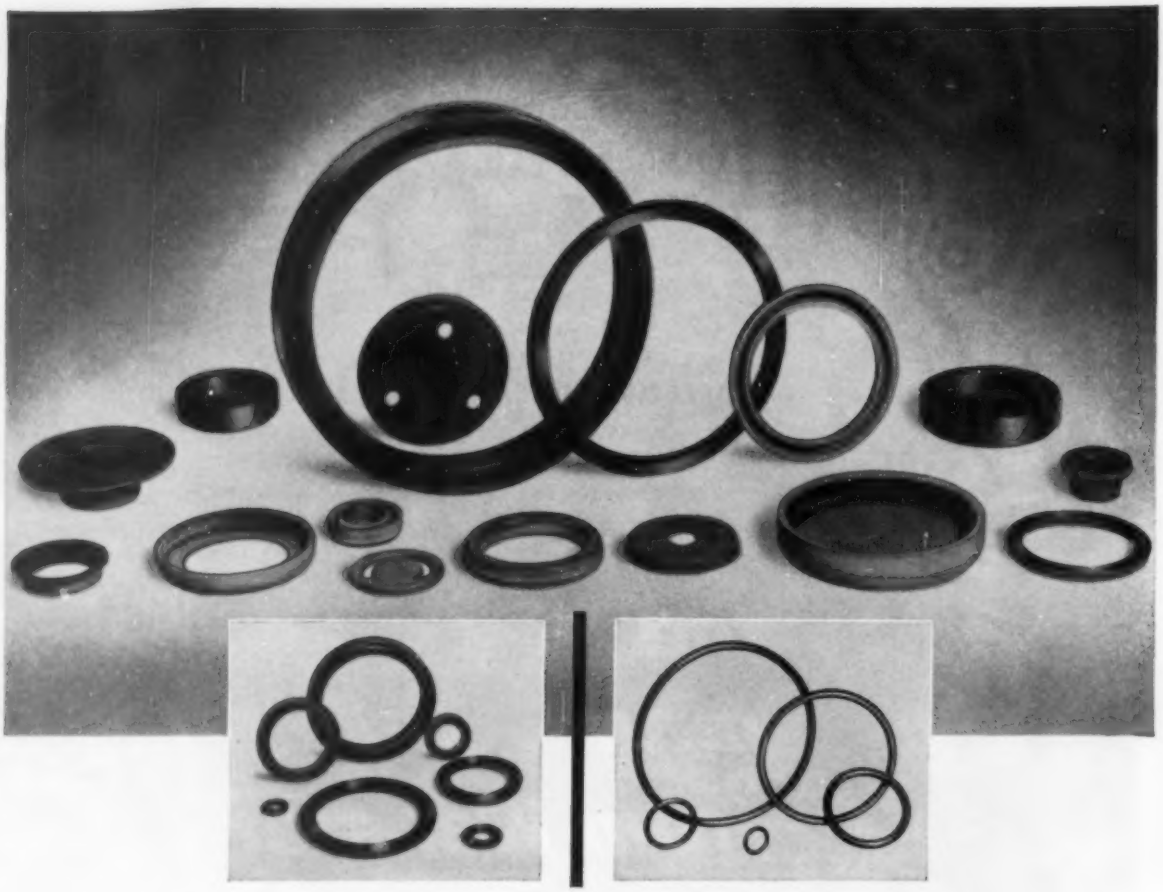

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LEATHER packings possess natural properties of toughness, resiliency and resistance to abrasion which have never been surpassed by man-made materials. They will give you high efficiency and longer life due to their low coefficient of friction and will operate smoothly under the most exacting conditions.

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FLUID POWER *Pioneers*

BABOO RAM (BOB) TEREE

UNDOUBTEDLY, Baboo Ram (Bob) Teree is one of the most outstanding figures in the field of fluid power in the United States.

He is probably best known for his work in the SAE Committee A-6 on Aircraft Hydraulic and Pneumatic Equipment, and has been chairman of this group since 1943. Fellow committee members credit Bob for the leadership which has resulted in outstanding achievement in standardization, cost reduction, reliability, and safety of aircraft hydraulic and pneumatic accessories.

The vitality of this committee is shown by the attendance of more than 250 aircraft hydraulic and pneumatic specialists at the semi-annual meetings. Such large attendance is unusual for technical committes.

Back in 1923, at the age of 21, Bob Teree left his native India to study engineering in the United States. Landing in San Francisco too late in the year to enter the University of Oregon as he had planned, he joined the Ford Motor Company Trade School in Detroit.

• **Holds Two Degrees**—Continuing his studies at the University of Michigan, he graduated in 1931 with Bachelor of Science degrees in Aeronautical Engineering and Engineering Mathematics.

• **Gained Flight Experience**—Bob started his professional career as a detail draftsman at Curtiss-Wright Airplane Division in Buffalo. He advanced to hydraulic engineer and then assistant chief of the structures department. Not content to be a "desk engineer", he went up on test flights to witness components in operation and learned the importance of reliability and safety of hydraulic components.

After World War II, Bob worked for the Weatherhead Company in Cleveland and then New York Air Brake Company in Watertown, N. Y. In 1956 he joined Greer Hydraulics, Inc. as Chief Engineer to work on hydro-pneumatic accumulators, aircraft testing and maintenance equipment, and other hydraulic components. In April of this year, he was elected Vice President in charge of Engineering and Manufacturing.

In addition to his activities in the technical committees of the SAE, Bob is an active member of the American Society of Mechanical Engineers. He is an associate fellow of the Institute of Aeronautical Sciences and the Royal Aeronautical Society. As Chairman of the Aircraft Section of the National Conference on Industrial Hydraulics, he will be active at the Chicago meeting this month.

• Fluid Power Pioneers . . . are selected by the editors of APPLIED HYDRAULICS to acknowledge outstanding contributions they have made in the use of fluid power to improve their company's products.

NUGENT FILTERS AND STRAINERS FOR HYDRAULIC SYSTEMS

LAMINATED FIBER DISC FILTERS

These are "extended area" filters utilizing an actual filtering surface area greatly in excess of the area of their containers. Will remove particles as small as 2 microns and will absorb foreign solids in excess of 2½ times its original weight before recharging is necessary. 125 psi working pressure. Capacities 1 to 1260 GPM depending on viscosities and pressure.

Fig. 1555-O, 1R and 1S are same body style. Uses one Fig. 1555E cartridge of corresponding size. Also available in duplex models with switching valve.

Duplex filter Fig. 1555BF-O. Also available in sizes 1R and 1S. Covers, valve manifold and bracket are one casting.

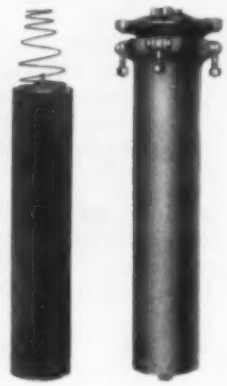


Fig. 1555-4L Filter uses one Fig. 1555E-4L cartridge. Also available in size 4S. Duplex models also offered.

High Pressure Models

Fig. 1555BA, sizes O and 1R. Rated for 300 psi working pressure.

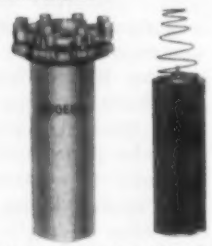


Fig. 1555AR, sizes 4S and 4L. Rated at 600 psi working pressure.

WITH MOTOR-DRIVEN PUMPS

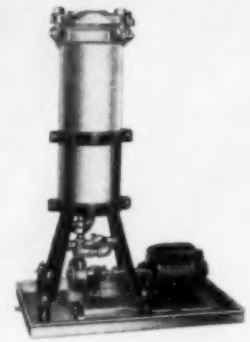


Fig. 1560 is a stationary unit composed of a Fig. 1555 Laminated Disc Filter (5 sizes with capacities ranging from 1 to 22 GPM available) connected to motor driven pump. Mounted on common base with drip pan.

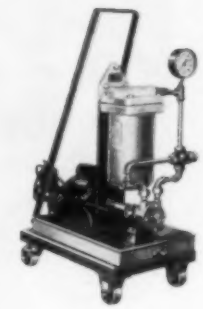
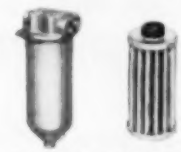


Fig. 1560A is identical in construction to Fig. 1560 and in addition is mounted on a dolly equipped with heavy duty casters for easy portability.

STAR SHAPED EXTENDED AREA STRAINERS



Strainer Fig. 1490AM-O uses Fig. 1490AW-O basket. Rated for 50 psi working pressure. Capacities: 12-25 GPM. 100 mesh or coarser.

Fig. 1490W-4R, 4S and 4L are high pressure strainers rated for 600 psi working pressure. Use Fig. 1490CN baskets of corresponding size. Capacities: 65-468 GPM. 100 mesh or coarser.

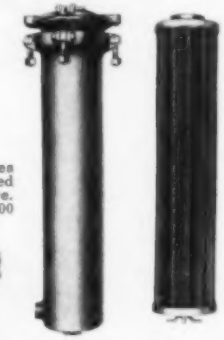


Fig. 1490DD-4L strainer uses one 1490CN-4L basket. Sizes 4R and 4S are same style. Larger sizes available. 125 psi working pressure. Capacities: 65-7500 GPM. 100 mesh or coarser.

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Circle 14 →

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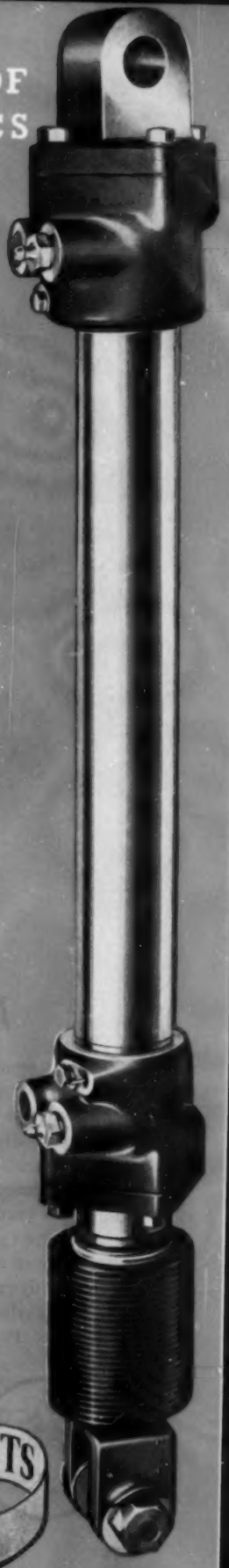

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FOR ALL HYDRAULIC UNITS

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Announcing

THE 1957 AWARD WINNERS

Each year The APPLIED HYDRAULICS Prize Paper Contest, which is open to all readers, produces papers describing many phases of hydraulic and pneumatic design, application, and maintenance. This year's entries represent advanced ideas in component design, machine system application, and theoretical development. These were judged by three outstanding authorities in the fluid power field: **B. I. Ulinski,** Director of Design & Development, Automatic Transportation Co.; **Earnest Y. Seborg,** Development Engineer, Ingersoll Milling Machine Co.; and **A. J. DeMatteo,** Chief Engineer, Watson-Stillman Press Div., Farrel-Birmingham Co., Inc. Each entry was evaluated on the basis of practicality, economics, originality, and presentation.

On the following pages the award winners are presented together with the three top prize papers. All papers which have received an award or honorable mention will be published in future issues.

First

AWARD PRIZE
$500

Jack Bendror

Jack Bendror, Assistant Chief Engineer, Printing Industries Equipment, Inc., New York, N. Y. "Modified Valves and Cylinders Permit Use of Hydraulics to Bind Books".

Obtaining completely leakproof operation was a primary design objective on this book binding machine. Special cylinders were designed to achieve this. Valves were modified to give a time delay and to reduce the total number required. Much piping was eliminated by the use of manifolds.

Second

AWARD PRIZE
$300

Maurice Beshouri

Maurice Beshouri, Hydraulic Engineer, J. N. Fauver Co., Inc. Detroit, Mich. "Feed Control Panels for Machine Tool Slides."

Hydraulic feed systems can frequently be simplified by using a feed panel which incorporates the directional and flow control valves. Various types of panels are compared to indicate proper application. Mr. Beshouri discusses spool leakage as a limiting factor in obtaining minimum flow, and the principle of avoiding sudden diversion of the fluid.

Third

AWARD PRIZE
$200

Conrad R. Himmler

Conrad R. Himmler, Technical Director, Centre de Recherches Hydrauliques et Electriques, Paris, France. "Hydraulic Position Servos . . . Design and Application."

Application of a recently developed torque amplifier incorporating a valve and fluid motor is the subject of this paper. This compact unit which has a high sensitivity and response rate is diagrammed in an electrical feedback system and in a pump servo system.

Fourth-Seventh Prizes

$50 EACH

Bruce Barton, Sales Engineer, Petch Manufacturing Co., Detroit, Mich. and **Robert Gignac,** Controls Engineer, Hautau Engineering Co., Ferndale, Mich. "A Booster and Work Cylinder in One Integral Unit." Describes the development of a combination unit for a special machine in which only one high force operation is required. Booster-cylinder eliminates a separate high pressure system or high pressure piping. Large bore cylinders could not be used because of space limitations and required cycle time.

Kenneth S. Knapton, Jr., Application Engineer, **Thomas T. Thompson,** Senior Systems Engineer, Sanders Associates, Inc., Nashua, N. H. "Electro-Hydraulic Programming of Structural Test Loads." Aircraft structural testing must be done in a predetermined, programmed, manner, usually over a very short time. The system for applying these loads must be fully automatic, taking its input from a computer or a function generator of either the mechanical curve follower or electronic type. The closed loop electro-hydraulic system answers the requirements, and the heart of this system is the electro-hydraulic servo valve.

Paul E. Straight, Electronic Engineer, Hagan Chemicals & Controls, Inc., Pittsburgh, Pa. "Matching Hydraulic Pump to Frequency Response." Paper aids understanding between control engineer who specifies system performance and hydraulic engineer who must interpret requirements such as frequency response in terms of pump performance. Shows how flow demand varies for two typical frequency response curves. The method can be extended to include any other frequency response desired.

S. F. Watanabe, Senior Engineer, Bendix Aviation Corp., Research Laboratories Div., Detroit, Mich. "Application of Hydraulic Servomechanism to the Bendix Cam Machine." Analyzes design of tape controlled machine for turning three-dimensional cams used in a turbo-jet engine fuel system. Accuracy and reproducibility in the order of .0002 inches is result of hydraulic servomechanism design. One important specification in developing the machine was that both spindle and cross-feed servos had to be capable of operating smoothly at nearly zero speeds as well as at higher speeds. Another requirement was to be able to stop the machine for tool changes and not lose position synchronization.

Honorable Mention

Russell W. Henke, Chief Engineer, Seaman-Andwall Corp., Milwaukee, Wis. "Unusual Design Requirements Breed Unique Hydraulic System."

Harry S. Mankey, Chief Design Engineer, Standard Manufacturing Co., Inc., Dallas, Tex. "Unique Hydraulic Components Make Successful Bomb Lift Truck."

G. F. Young, Manager General Engineering, The Raymond Corp., Greene, N. Y. "Production Testing and Applications of Low Voltage Hydraulic Power Units."

Robert Rosencranz, Chief Engineer, Standard Stamping & Perforating Co., Chicago, Ill. "Hydraulic Pressure System for Feed Rolls."

B. H. Rawls, Proposal Engineer, The Hydraulic Press Mfg. Co., Mt. Gilead, Ohio. High Speed Shell Piercing Press.

Leo Braun, Technical Assistant to Works Manager, Dominion Bridge Co., Ltd., Lachine, Quebec. "A New Application of Fluid Power to a High Speed Milling Machine."

William R. Abell, Chief, Fixed Bridge Test Section; **John K. Singleton, Jr.** Project Engineer, U. S. Army Engineering Research & Development Laboratories, Fort Belvoir, Virginia. "Hydraulically Launched Assault Bridge."

D. F. Turton, Design Engineer, Industrial Hydraulic Div., Plessey Co., Ltd., Swindon, England. "The Use of Soft Seals in Hydraulic Pistons."

Z. C. Van Schwartz, Director of Engineering Standards, Baldwin-Lima-Hamilton Corp., Hamilton, Ohio. "The Shape of Things to Come—Hydraulically."

O. G. Beardsley, Stevensville, Mich. "Differential Cylinder."

Fritz Krafft, Chief Development Engineer, The Thompson Grinder Co., Springfield, Ohio. "Compensating Hydraulic System Reduces Heat in Surface Grinders."

Sanford Ellis, George M. Pearse & Co., Newark, N. J. "The Influence of Power on Hydraulic Circuitry."

B. F. Cummins, Kingston, N. Y. "Chordal Actuators."

J. A. Folse, Bureau of Aeronautics, U. S. Navy, Washington, D. C. "Tensor Analysis Applied to Hydraulic Networks."

Jack Bendror

A New Application:

MODIFIED VALVES AND CYLINDERS

. . . permit use of hydraulics to bind books

Much original thinking went into the hydraulic design of this machine which is used in a field where leakage can be especially troublesome. Additional problems of space and cost were overcome by ingenious combinations of hydraulics, mechanics, and electrical controls.

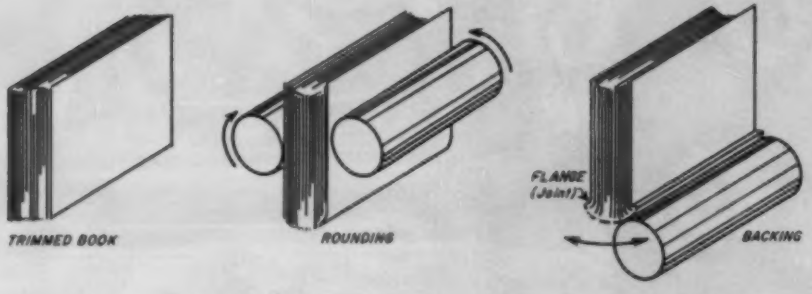
ONE of the primary concerns in designing machines for the bookbinding industry, is control of leakage. In selecting cylinders for this machine which performs two operations in rebinding books, almost all the cylinders which industry had to offer did not have provisions for collecting the oil leakage created at the rod ends. This problem was overcome by designing cylinders with an extra port to channel the leaking oil separately back into the tank.

Some cylinders, however, remain as conventional design. With the exception of one cylinder, all cylinders are above the oil tank level, and their leakage can be gravity fed into the tank. The machine is designed so that leakage from these cylinders drops into a wide recess which tapers from front to rear, away from the working area. Collected leakage oil is then drained back into the reservoir.

One cylinder posed a special problem, since the design required that its leakage port be below the reservoir oil level. The solution was a simple pumping arrangement using the rod end of the single-acting LIFT cylinder, shown on the hydraulic circuit, as a pump. During the retraction stroke, oil is sucked from the leakage port of the CENTERING AND SWINGING cylinder into the chamber between the two check valves connected in series. The extension stroke of the LIFT cylinder then displaces the oil trapped in this chamber into the reservoir.

Another leakage control measure was to hold piping to a minimum. Sub-plate valves are mounted on manifolds in which all interconnecting passages are integrally drilled. Wherever possible, components such as check valves and pressure switches or throttling valves have been built into the same

WHAT DOES THE BOOK BINDER DO?



Rounding and backing are performed on the back of a book prior to the application of its cover. The rounding operation is the forming of the familiar concave shape of the front of the book. In this machine, this is done by rolling the book down between two rounding rollers pressed tightly against its sides. Because a greater downward force is applied to the center pages than the end pages, the center pages move farther, giving the rounded shape to the book.

Backing the book is the formation of a flange on both sides of the back to give the cover a better support. The backing roller is held tight against the book and swept across the pages four times. The flange is formed as the pages bend over the sharp edges of the jaws which clamp the book during this operation.

Because of the total lack of uniformity of their work, library binders were prevented from using automatic machinery, and until recently all work had to be done manually. The quality of work was largely dependent on the skill of the operator. The development of the new hydraulic rounder and backer under the guidance of Leo Robbins, offered this industry a machine that could automatically round and back books without requiring any resetting for the various sizes and with a capability of doing an average of 650 books per hour instead of the usual 400 books per day. The requirement for a skilled operator was eliminated.

MODIFIED VALVES & CYLINDERS

manifold. This arrangement incorporates all lines except those hoses which must be connected to the various moving parts and cannot be built into the manifold. Apart from saving space and being very neat, this arrangement has the least possibility for leakage. Also the efficiency of the circuit is increased because flow paths are shorter and line pressure drop is kept at a minimum.

CIRCUIT DESIGN

The circuit itself presented complex problems. To design a circuit for a multi-station machine

HOW THE MACHINE OPERATES

On actuation of switch S-2, solenoid *A* of valve 2 is energized and the following actions occur simultaneously:

a. The pivoted frame that holds the rounding rollers is lifted by a cam, actuated by a spring working against the LIFT cylinder.

b. The book-support plate powered by the BOOK-SUPPORT cylinder advances under the rounding rollers.

C. The rack of the rounding roller drive cylinder retracts in preparation for its power stroke.

d. The control pedal becomes operative. By depressing switch S1, when necessary, all the above actions can be cancelled.

A book is then inserted between the rounding rollers with its back resting on the book-support plate. The working cycle is started by depressing the control pedal. This pedal must be kept depressed continuously throughout the entire working cycle. Should the pedal be released at any time, the machine will immediately release the book and return to its initial idling position, thus eliminating the possibilities of jam-ups. Depressing the control pedal causes the movable rounding roller to move toward the fixed rounding roller to grip the book. Following this, the book-support plate automatically retracts from under the back of the book now held between the rollers.

Here is one place where the positive sequencing system of initiating succeeding operations shows its great advantages over other systems. If the moving rounding roller fails to advance, or does not advance far enough to be able to clamp the book, the supporting plate should not retract. If it does, the book will drop down out of control. Pressure switch 10-PS is used to sense the actual gripping of the book by the rounding rollers.

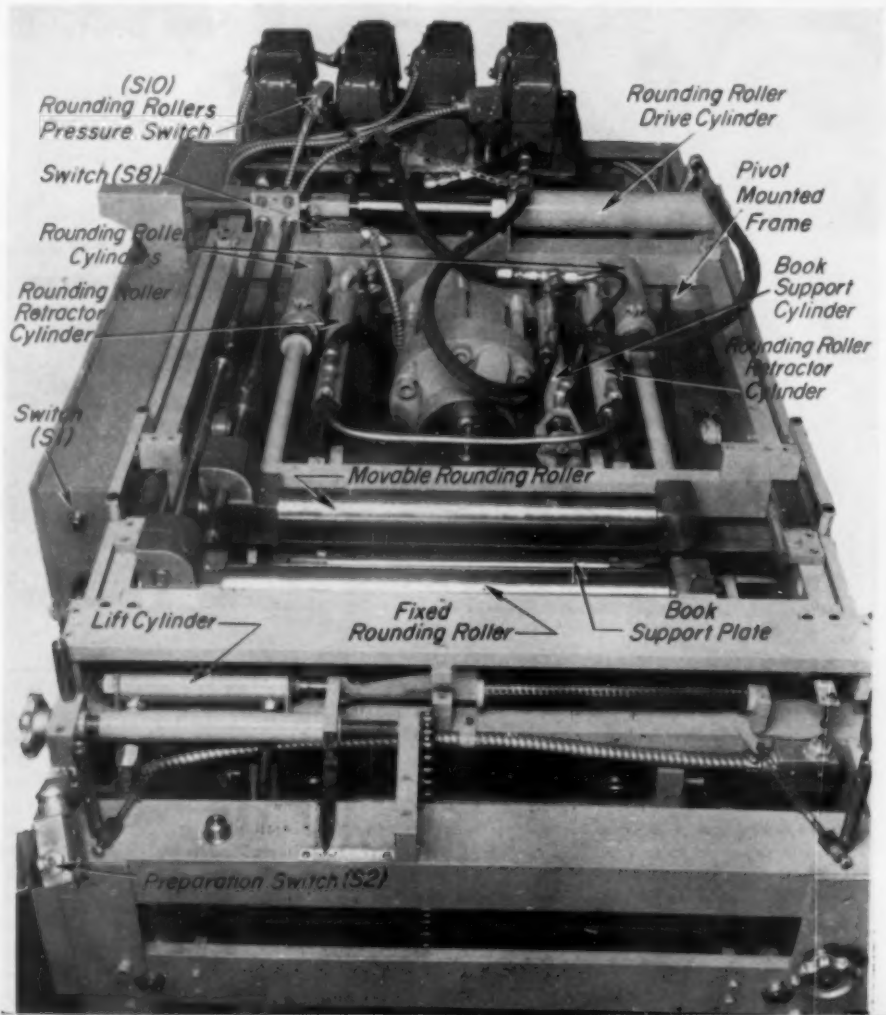


FIG. 1. TOP VIEW OF THE MACHINE shows cylinder arrangement and minimum piping to control leakage. Several of the cylinders have been modified with an extra port to channel leakage back to tank.

would be a simple matter if one tolerated great extravagance in the selection of controls and components, and where space was not a limitation. However, both the economic as well as the limited space considerations were of great importance, the latter being quite significant to the users.

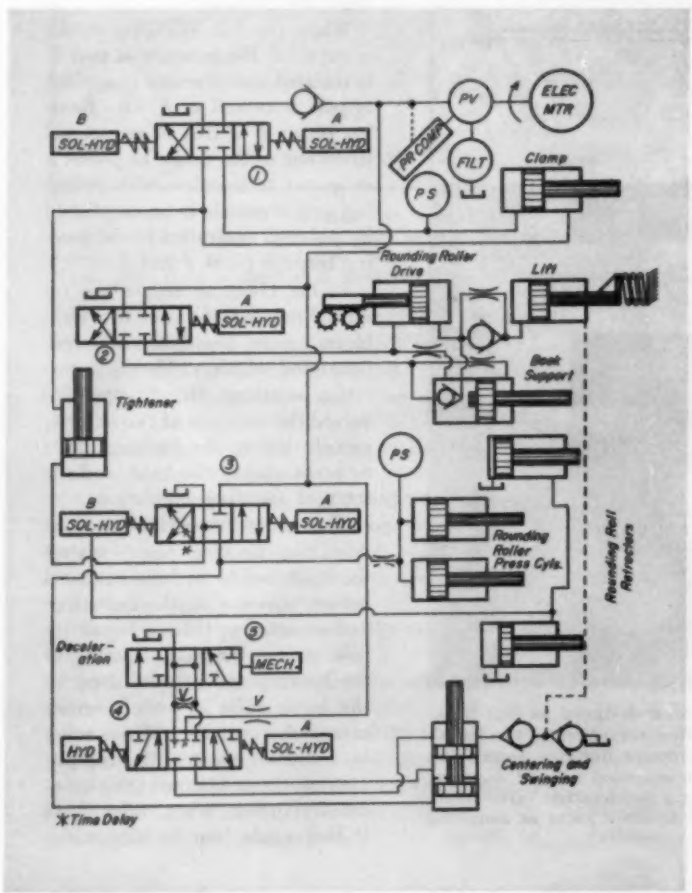
The original design started with six solenoid-controlled, pilot-operated, 4-way valves and ended with four. One of the four is a standard 4-way modified into a 5-way to work in conjunction with a stem-operated deceleration valve.

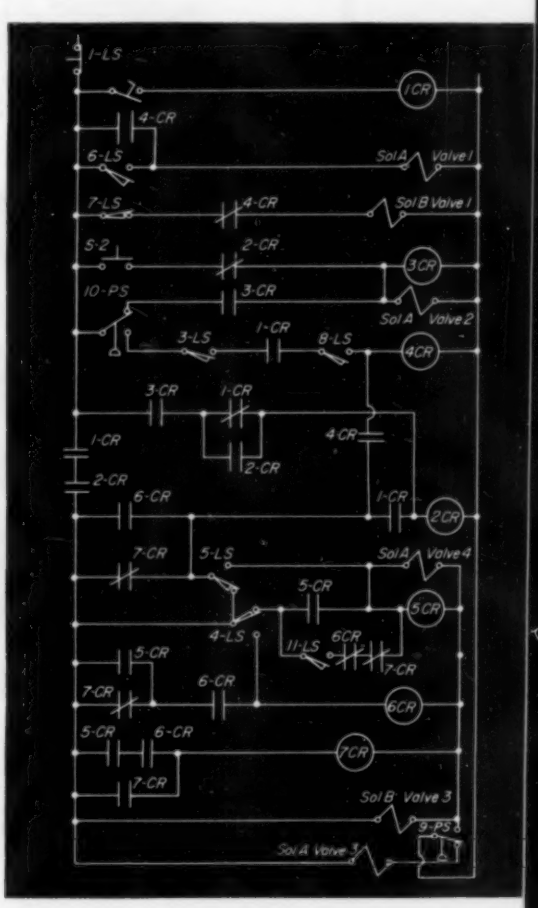
Purpose of the deceleration valve is to provide for a backing roller to decelerate at each end of its stroke and thus eliminate any mechanical shock when the roller goes through direction reversals. Taking into consideration all the inertial effects of

When the piston of the BOOK-SUPPORT PLATE cylinder has retracted to its full rear position, it pushes open a sequence valve built into the rear of the cylinder. The opening of this valve allows oil to flow and power both the rounding roller drive and lift cylinders which cause the rotation of the rounding rollers and the descent of the frame respectively.

The completion of the rounding rollers rotation, as well as the lowering of the frame, is sensed by two limit switches 8-LS and 3-LS wired in series. Only after both of these are acuated by the completion of the strokes of the ROUNDING ROLLER and LIFT cylinders respectively, will relay 4-CR be energized to power solenoid A of valve 1. This will cause the movable jaw to advance toward the fixed jaw and to clamp the book between them in the proper position for rounding, with a portion of the back of the book projecting below the jaws. Again another pressure switch, 9-PS, is used in the same manner as pressure switch 10-PS to sense the proper clamping of the book by the jaws.

When the book is brought down to its backing location, the backing roller is already in its central or midway position, brought there at the same time when the ROUNDING ROLLER cylinders were powered. As soon as pressure switch 9-PS is actuated, solenoid B of valve 3 is energized and the tightener cylinder is powered to bring the backing roller up to press against the center of the back of the book. The CENTERING-AND-SWINGING cylinder causes the backing roller to move back and forth several times along an arc across the back of the book, thus forcing it to assume the desired backed shape. After the cylinder has completed a predetermined number of strokes, the counting of which is accomplished by two limit switches, 4-LS and 5-LS and three relays 5-CR, 6-CR, and 7-CR, the backing roller retracts. The jaws now separate, releasing the book which falls down through the guide chute onto conveyor belts which are driven by a fluid motor and carry the finished book out of the machine.





the moving parts, the highest possible speed was used. The backing roller travels at full speed for most of its movement and decelerates only towards the very end.

The common arrangement using conventional deceleration valves would not work because the swing of the backing roller is different for each size book. Figure 2 shows the linkage for actuating the deceleration valve. Actuation of the long link at any point will have the same effect in actuating the valve.

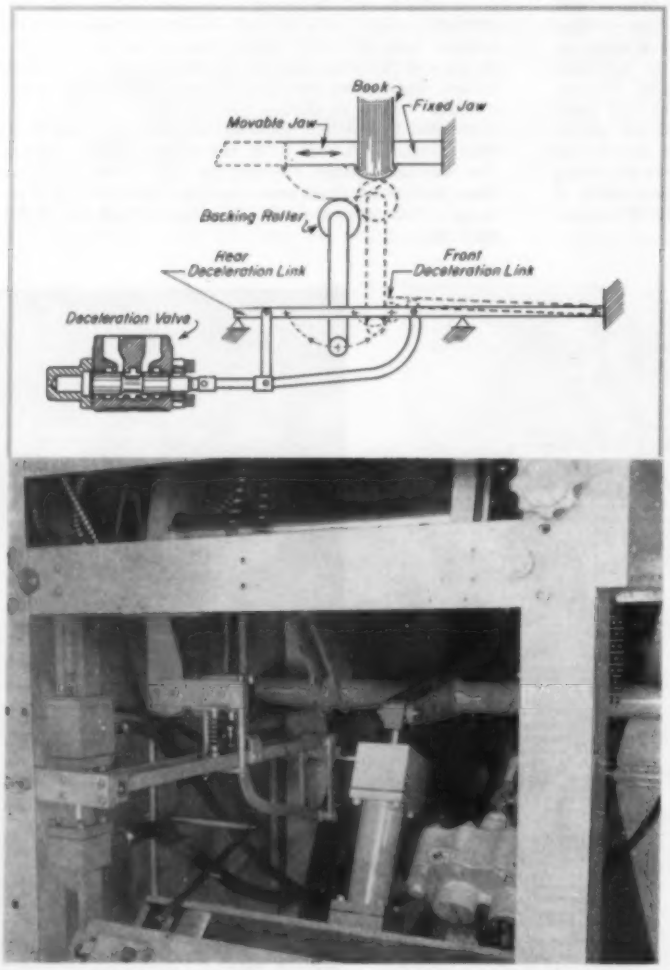


FIG. 2. DECELERATION LINKAGE has been designed so that backing roller decelerates at each end of its swing regardless of the length of arc. Extension from backing roller actuates linkages controlling deceleration valve. Regardless of book size actuation of rear deceleration link at any point causes same effect on deceleration valve spool. Front deceleration link is always actuated at same point as rounding roller approaches fixed jaw.

DUAL PURPOSE CYLINDER

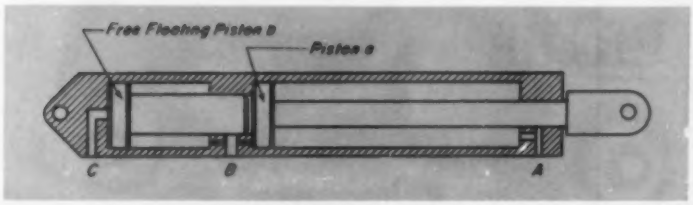
In the original design, there were two pivot-mounted cylinders coupled at their piston ends to power the backing roller through its cycle. One was powered only at an early part of the cycle to center the backing roller. Following this, this cylinder merely went along for a ride during the rest of the movement, as the second cylinder swung the backing roller back and forth across the book. It soon became obvious that this unnecessary motion of the floating cylinder created an extra drag. Also this cylinder required a separate valve.

Figure 3 illustrates the revised design of a 3-position cylinder which is called the CENTERING-AND-SWINGING cylinder. This eliminates the unnecessary motions. In order to center the backing roller under the clamped book, pressure is applied at ports *A* and *C* simultaneously. Because of the difference of areas between the rod end of piston *a* and the head end of piston *b*, piston *b* advances to its full stroke and pushes piston *a* forward. The backing roller which is coupled to piston *a* moves as far as piston *b* permits. This is to the center of its stroke under the book.

When the full swinging stroke is required, the pressure at port *C* is released and pressure is applied to port *B* as well as *A*. Free floating piston *b* is free to retract entirely out of the range of piston *a* so as not to interfere with swinging action which is accomplished by piston *a* controlled by oil passing through ports *A* and *B*.

In the effort to reduce the required number of valves to a minimum, some problems were encountered which yielded to interesting solutions. One of these involved the response of two actions, namely lifting the backing roller to press against the book and the start of the first oscillation.

The TIGHTENER cylinder which holds the backing roller against the book had to be fully extended before piston *a* in the centering-and-swinging cylinder began its first stroke. Since the raising of the backing roller is initiated by the same valve 3 which earlier caused the centering of the roller by activating the free floating piston *b* of the CENTERING-AND-SWINGING cylinder, when valve 3 is shifted again, the backing roller



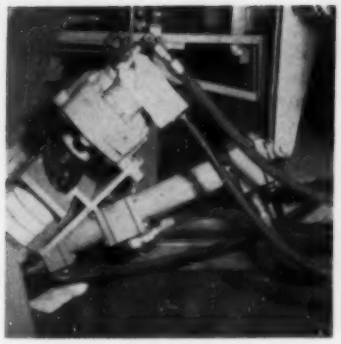


FIG. 3. 3-POSITION CYLINDER has been designed for the centering and swinging operation. Cylinder has two separate pistons. When pressure is applied at *C* and *A*, piston *b* advances piston *a* because of the difference in areas. This positions backing roller under book. Removing pressure from port *C* and alternately applying pressure to ports *B* and *A* gives swinging action to backing roller.

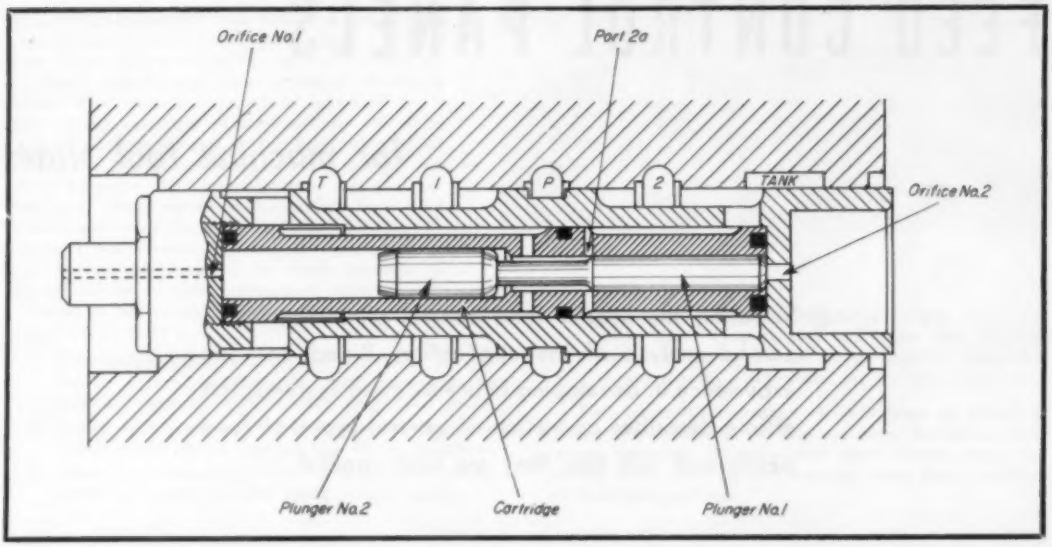


FIG. 4. VALVE MODIFICATION has been designed to give a time delay. Cartridge was pressed into a standard valve spool and two plungers inserted. When pilot fluid is applied to shift the valve to the right with both plungers at the left position, there will be a time lapse before plunger No. 2 pushes plunger No. 1 far enough to open port 2a allowing the oil from port 2 to drain.

will try to swing back before limit switch LS-11 which controls valve 4 can be tripped.

This called for a very short time delay in the magnitude of only 1/10 second before the free floating piston *b* of the CENTERING-AND-SWINGING cylinder could be released.

A hydraulic time delay was found to be the best solution. Furthermore this delay was built into the standard spool of valve 3 which was modified slightly. Figure 4 shows the necessary modification of the main spool of this valve.

When the pilot pressure shifts the main spool to the left, the stepped plunger No. 1 is also shifted to the left by the same pilot pressure, thus blocking the tank port 2a through which port 2 will later have to drain. When the spool shifts to the right because of the reversal of pilot pressure, the TIGHTENER cylinder will immediately engage. However, there will be a time lapse before plunger No. 2 pushes the stepped plunger No. 1 far enough to open port 2a allowing the oil from port 2 to drain. As long as port 2 cannot drain, the free floating piston *b* of the CENTERING-AND-SWINGING cylinder cannot retract and the swinging action cannot begin.

SEQUENCE CONTROL

There are various ways of insuring the proper sequence of operations in a multi-station machine. The succeeding operations could for example be initiated on a time schedule through the use of commercial timing devices, or by a programming cam. Nether of these or similar systems were acceptable on this machine, because if the time cycle of a particular operation changes for any reason such as in a jam-up, the signal for the next operation may be given regardless of the disorder. Therefore such systems were considered unsafe and were not used. Instead, succeeding operations are initiated by limit switches and pressure switches signalling completion of the preceding operation. ▼▼▼

SECOND PRIZE

Maurice Beshouri

FEED CONTROL PANELS

. . . for machine tool slides

Selecting the proper feed control panel requires a careful analysis of the application. Based on wide experience in developing hydraulic feed systems, this article describes operation of several types of feed panels and tells how they are best applied.

HYDRAULIC feed circuits designed with individual valves have presented difficulties such as messy piping, excessive maintenance, and physical space problems. Many hydraulic feed circuits can be simplified and built more economically when various valve functions are combined in one compact feed control panel. The panel usually includes directional control, feed selector, and pressure compensated flow control valves in one unit and is a complete circuit to control a work slide.

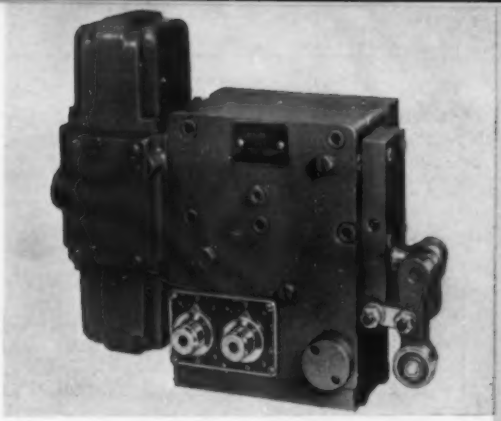
In a feed panel having a direct, solenoid-operated directional control, usually a large solenoid is necessary to provide the shifting force, because of the high friction and large centering springs. Large solenoids mean greater inrush and holding currents and also bulky overall design. The price for such units and replacements is very high.

PILOT-OPERATED PANELS

Feed panels having pilot-operated directional controls offer many advantages. The piloting mechanism which contains considerably smaller solenoids is manifolded to the basic directional unit. This design permits controlling the rate at which the main spool moves, and deceleration and acceleration of the machine slide. Positive control is a result of greater pilot force on the directional spool compared to solenoid push. The length of the directional spool travel is not limited by the solenoid stroke, and this affects the degree of throttling. Finally a pilot spool has a smaller surface of contact minimizing the possibility of sticking.

On new applications, the pilot-operated directional control is, perhaps, more widely used now than the direct solenoid type. In certain applications, the direct solenoid-operated type performs satisfactorily and may be somewhat more efficient, especially on jobs where high shifting speeds are required. However, a pilot-operated type, with sufficient pilot pressure, may closely approximate the shifting time of a direct solenoid design.

The solenoid-controlled, pilot-operated feed panel is typically a meter-out type, ideally suited for negative or overhauling load applications where the work tends to pull the cylinder faster than the desired feed rate.



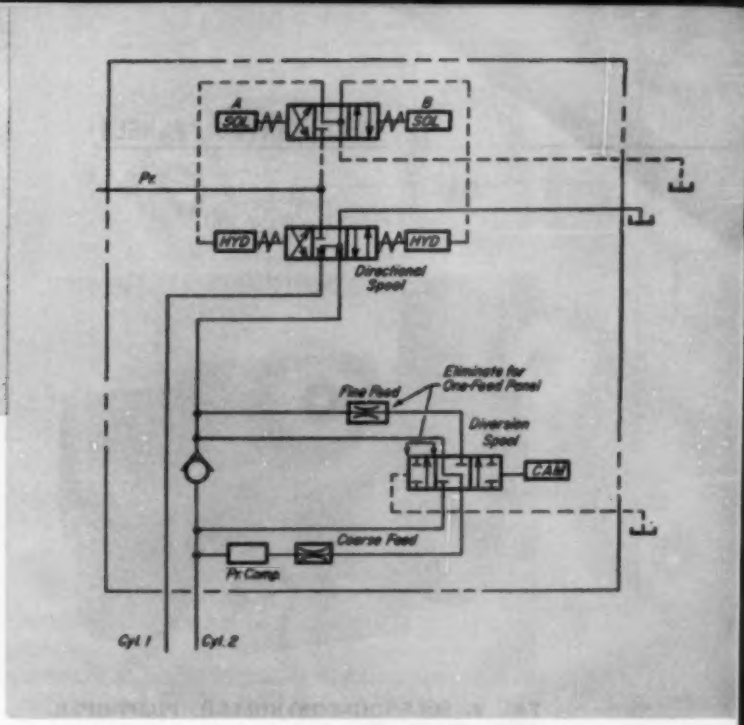


FIG. 1. CAM-OPERATED FEED PANEL. The cam-operated feed panel is usually a 2-feed unit which has a solenoid, pilot-controlled directional spool and cam-operated diversion spool. The diversion spool is actuated by a dog on the machine slide. Generally this type of panel is considered as an integral part of a machine and is mounted directly on the machine member. This arrangement has two advantages. First, smoother transition into feed is obtained since the shape of the actuator determines the degree of control. Second, feed may be started closer to the work because of the reliability of the mechanical control.

Some of the main design features of the cam-operated panel are:

1. **Two independent rollers are provided in different planes, so that the reset cam can be installed without interference with feed cams.**
2. **A ball detent is provided to locate the diversion spool positively in one of the three positions.**
3. **Reset for succeeding cycles may be accomplished at any point on the rapid reverse cycle.**
4. **Diversion spool is depressed during coarse or fine feed. This assures safety in case of solenoid failure or in the event that the reset follower was not depressed on the reverse cycle.**

The main disadvantage to this type of panel is space requirements on the machine member. It is more desirable to have the panel away from the actual work slide of the machine with limit switches to indicate position.

The greater the amount of oil metered out, the more accurate is the control. For this reason it is recommended, whenever possible, to meter out of large cylinders. Most of these feed panels are constructed to meter a minimum of 5 cu. in./min. for coarse or fine feed. However, it is recommended to keep well above the minimum of 5 cu. in./min. to assure long life. If a minimum feed rate must be maintained, it is always considered good practice to select the next larger bore of cylinder to allow metering more oil. In the long run, this practice is sound, in view of the expected wear and future system problems.

These panels are normally designed for 1000 psi working pressure and for cylinders with piston-to-rod ratios not to exceed 2 to 1.

DESIGN FEATURES OF SOLENOID PANELS

In a feed panel having a blocked port directional spool, if power fails the work slide stops instantly preventing any damage to the tools or the part.

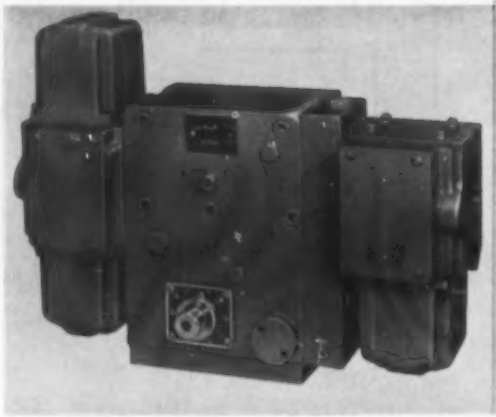
The pilot pressure line for the directional control is connected through a small capacity check valve before entering the pilot valves. The check valve prevents the main spool from shifting back to neutral position when the slide resistance in rapid advance and rapid return creates a pressure lower than that necessary to hold the spools in the shifted position. This design insures smooth travel during rapid advance or rapid return when the slide resistance to motion is very small.

To stop the slide in a dwell position, only one solenoid needs to be de-energized. This acts as a safety stop in the event that a stop is desired during any phase of the cycle.

The panels are also available with external pilot connections if pilot pressure must be taken from the main pressure source. The pilot valve which actuates the main spool is normally furnished with a spool having the pressure chamber blocked and the remaining ports open to tank in neutral position. This drains both sides of the main spool, so that it is relaxed in the neutral position.

An open center directional pilot valve in a feed panel can be used as a means of venting the relief valve. A power unit with a double pump of the hi-lo

FEED CONTROL PANELS



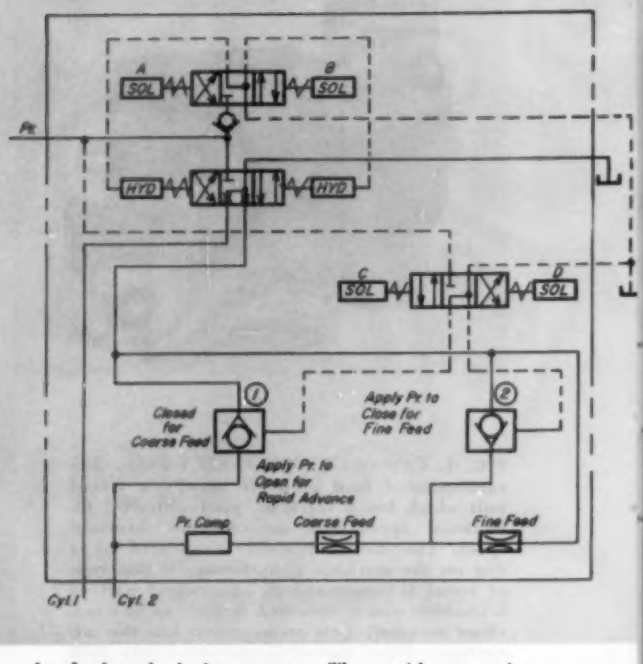


FIG. 2. SOLENOID-CONTROLLED, PILOT-OPERATED PANEL. The single-feed panel is the most widely used for conventional applications of rapid forward, feed, dwell (if desired) and rapid return to a stop position. It is remotely controlled by electrical devices such as limit switches, timers, or electronic controls.

The panel consists of a single feed unit with solenoid-pilot operated directional spool and feed selector assembly. When the feed solenoid is de-energized, the machine slide is in feed. This is a safety measure in case of an electrical failure while the feed cycle is in progress. The rapid return is independent of the feed mechanism.

One disadvantage, in comparison to the cam-operated panel is that if the feed spool hangs up, the panel will not drop into feed. This can cause considerable damage in tools and alignment. Another disadvantage is that precise positioning of the slide at the beginning of feed is impossible, since a time must elapse after droppng out the coarse feed solenoid to allow smooth deceleration. Slight variations of position are possible with temperature and viscosity changes in the fluid.

type (integral relief, check, and unloading valve) plus this feed panel is a complete feed circuit with features that reduce system problems caused by heat. When the directional pilot valve spool is in the neutral position, the relief valve is vented and the pump capacity is by-passed to tank across the relief with a minimum pressure of 50-65 P.S.I. A check valve in the vent line prevents any back flow when the pilot spool is shifted. Pressure builds up when the directional valve shifts, blocking the vent line.

CLAMPING FUNCTION

A clamp cylinder used in connection with a feed control panel, as shown in Figure 4, is normally pressurized from the same power unit unless the clamping force is comparatively great and must be constantly maintained. The 4-way valve actuating the clamp cylinder is a standard, solenoid-controlled, pilot-operated, 2-position valve, except that the pilot spool is 3- position. Also, instead of being the conventional type with pressure blocked and remaining ports open to tank, a standard, open-center spool is used to vent the relief. The main spool is held mechanically in the two positions with detents. When the pilot spool is centered, the part is unclamped and the relief is vented. To start the cycle, solenoid *E* is energized to shift the pilot spool blocking the vent line connection. Solenoids *E* or *F* must be held energized during the completion of the cycle. The purpose of check valve *G* is to prevent any back flow during rapid advance.

If the clamping force must be maintained during rapid advance, a sequence valve can be incorporated ahead of the feed panel, but it must be set lower than the unloading valve.

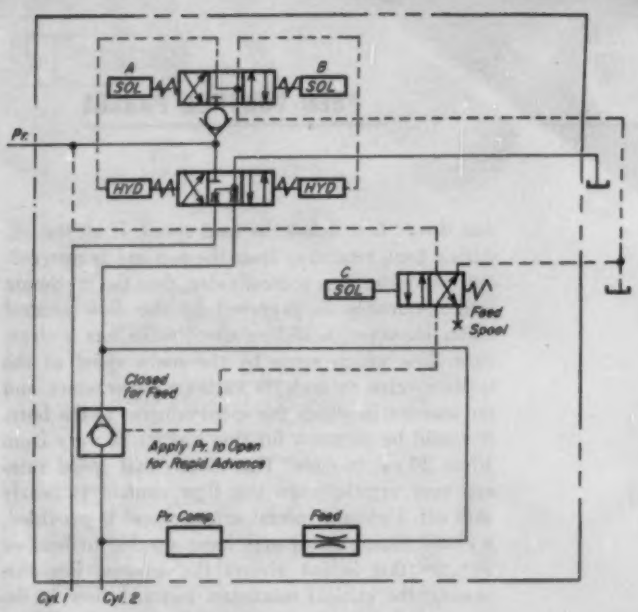
FEED IN BOTH DIRECTIONS

A single or dual feed panel can be used in circuits where it is desirable to feed in both directions. This is accomplished by employing an externally piloted 4-way valve in the cylinder lines as shown in Figure 5. This method works well on machine tools designed so that the machine operation is identical on both ends of one common slide. While the feed cycle is resumed in one end position, the other end is loaded for the cycle reversal. The cylinder must be of the double rod-end type with piston rod diameters equal, so that the feed rates

FIG. 3. DUAL FEED CONTROL PANEL. Dual feed control panels are used in applications where two feed rates are required. When solenoid *A* is energized, oil entering the pressure port is directed towards the CYL. 1 connection moving the work slide forward. By energizing solenoid *C*, pilot pressure is directed to open check valve 1 and return oil is directed to tank.

Coarse Feed—When solenoid *C* is de-energized, check valve 1 closes. The oil entering CYL. 2 connection is channeled through the pressure compensator and coarse feed valve. Since pilot-operated check valve 2 is open, the oil then flows to tank. The poppet of check valve 1 is held tightly against its seat, preventing any flow to tank.

A few drops of oil leaking across this check valve will affect the feed setting considerably in coarse or fine feed since this flow would not be held constant by the compensator. The pressure applied against poppet valve 1 is equal to the relief setting, less the pressure required to do the work, times the ratio of the areas of the ends of the cylinder.



Fine Feed—When solenoid *D* is energized, pilot pressure is applied against check valve 2 maintaining a leak-proof shut-off. Therefore, the metered oil leaving the coarse feed valve can only flow through the fine feed valve. The fact that the valves are connected in series, gives a smooth transition rather a stop when dropping into fine feed.

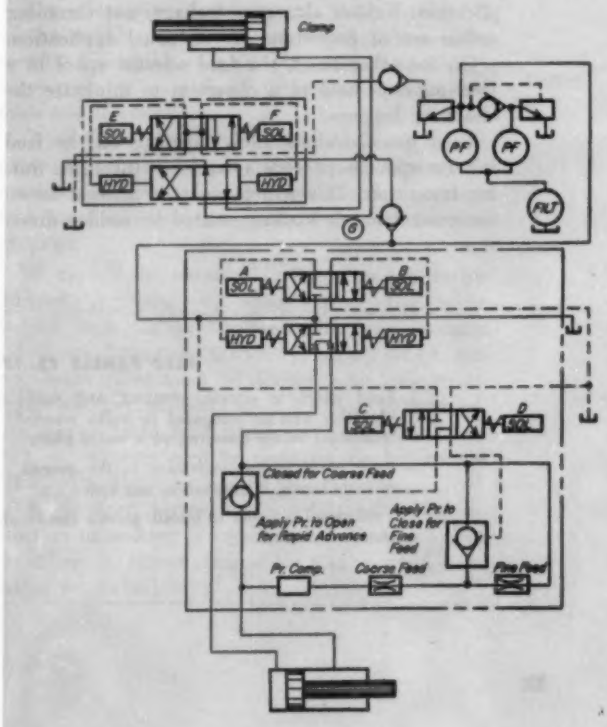
FIG. 4. CLAMPING CYLINDER can be powered from same source as feed panel. Valve controlling clamp cylinder has 3-position pilot spool and 2-position main spool. When pilot spool is centered, part is unclamped and relief is vented.

are identical in both directions. In the event that the piston rod diameters are different, the feed speeds will be different. If the difference is sufficient to affect the operation, and if the same feed rate is necessary in both directions, then it is possible to use a dual feed panel with the coarse feed as the control in the other direction.

FEED CIRCUITS WITH INDIVIDUAL VALVES

In some circuits, individual valves are used to form a feed circuit. The performance of these designs is hydraulically sound, however the merits of each individual circuit must be weighed against the machine requirement before any selection is made. These circuits should be carefully compared with the corresponding feed panel.

The circuit shown in Figure 6 is suitable for feed rates which are not critically low. The metered flow must be well above the clearance leakage of the sliding spool valve. In this circuit, the closed center 4-way valve acts as a directional valve to control the direction and stopping of the cylinder. The tan-



dem 4-way is to select the feed speed. If all the oil, during feed, returning from the rod end is metered-out across the flow control valve, then the minimum feed obtainable is governed by the flow control valve. However, a sliding spool valve has a clearance flow which seeps by the main spool of the tandem valve to tank. It varies with pressure and the manner in which the spool adheres to the bore. It would be common for this leakage to vary from 10 to 20 cu. in./min. This means that speed rates are very erratic when the flow control is nearly shut off. Unless a special arrangement is provided, a closer fitting spool may hang up due to heat or dirt, so this is not always the answer. For this reason, the critical minimum metered flow is determined by the clearance leakage of the tandem 4-way rather than the minimum rated capacity of the flow control.

In rapid advance, solenoids *B* and *C* are energized. During feed, solenoid *C* is de-energized readily shifting the main spool to the center position. This sudden diversion of the oil creates a jumpy action and sets up undesirable shock-waves in the hydraulic system. To minimize this undesirable condition, the feed spool of the tandem valve must be properly tapered to bring about a degree of deceleration. This circuit is not desirable for extremely low feed rates and smoothness is accomplished only when the feed selector spool is adequately tapered.

The tandem 4-way valve is a standard valve which is designed and constructed for conventional application. Neither clearance leakage, nor throttling action are of importance to its usual application.

On the other hand, the feed selector spool in a feed panel is held to a closer fit to minimize the clearance leakage.

Feed panel designs allow tapering on the feed selector spool to provide a degree of throttling during transition. This will prevent or at least lessen the great dynamic loading created by sudden diversion.

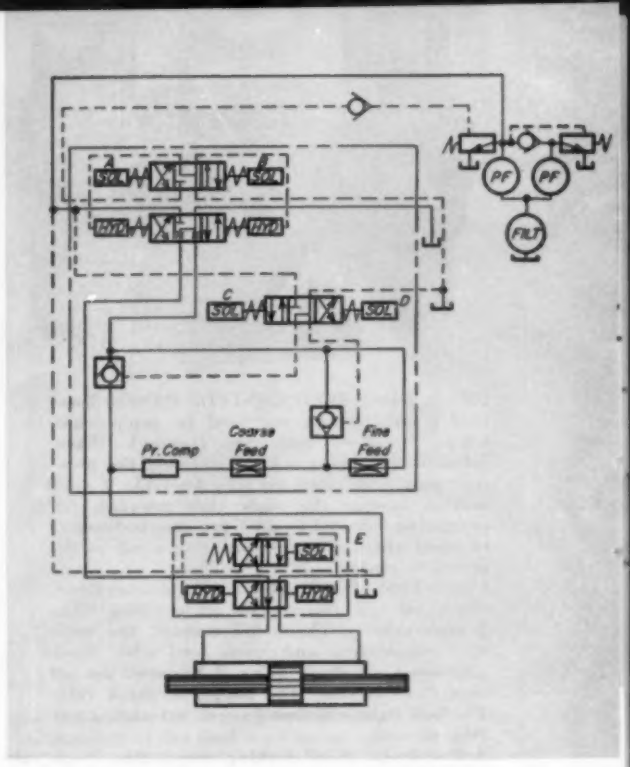


FIG. 5. CONTROLLED FEED IN BOTH DIRECTIONS is accomplished by using double rod end cylinder and externally piloted 4-way valve. If same feed in both directions is needed and cylinder rod diameters are different, a dual feed panel can be used with coarse feed controlling rate in one direction.

FEED CIRCUIT WITH PILOT-OPERATED CHECK

There are a number of applications where low feed rates are sufficiently critical to warrant the use of a poppet-type, pilot-operated check. The check is practically leak-proof in the closed position. This guarantees minimum metered flow which is difficult to obtain with the sliding spool type. However, standard pilot-operated checks are hard to control and give pronounced shock and roughness as compared to the circuit of Figure 6 or any feed panels.

In the circuit of Figure 7, while solenoids *A* and *C* are energized for rapid forward, the oil returning from the rod end of the cylinder is discharged to

FEED PANELS VS. INDIVIDUAL VALVE CIRCUITS

1. Feed panel is simple, compact and easily replaceable unit as compared to bulky manifold or individual valves mounted on a metal plate.
2. Feed panel is less expensive in the overall cost of installation, maintenance, and space.
3. Feed panel is easier to install, service and trouble-shoot.
4. Necessary to stock only one replacement feed panel compared to three or four valves.
5. Standard valve units have considerably more leakage than feed panels and have minimum metering as high as 40 cu. in./min.
6. Standard valves may give poor control of reversals and transitions from one speed to another.

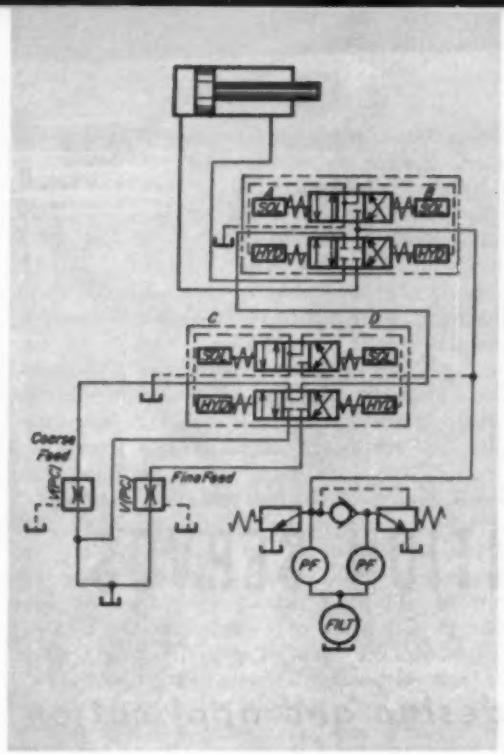


FIG. 6. CIRCUIT USING INDIVIDUAL VALVES can be used for feed rates which are not critically low. Metered flow must be well above clearance leakage of sliding spool valve. Leakage can vary from 10 to 20 cu. in./min. and higher, and speed rate is erratic when flow is nearly shut off.

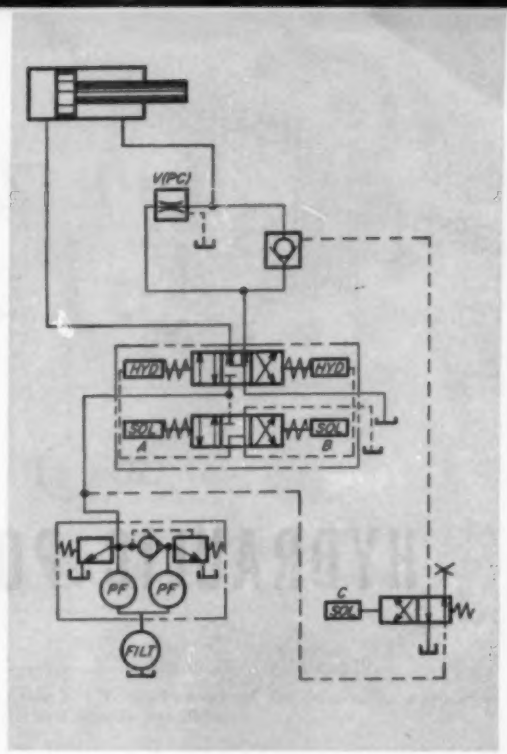


FIG. 7. LOW FEED RATES can be obtained with individual valves using poppet-type, pilot-operated checks. These guarantee minimum metered flow requirements, but are hard to control and can produce shock and roughness because of the sudden change in fluid direction.

tank across the pilot check and 4-way according to the displacement of the pump. As soon as solenoid *C* is de-energized, during the feed phase of the cycle, the pilot check shuts off tight forcing the oil through the flow control.

The roughness developed in the system is mainly due to the sudden change in direction of a mass travelling at high velocity. If this change is made gradually, then the impact is minimized.

In a feed panel the degree of control is accomplished by two conditions. First and most important is the design of the poppet stem of the pilot operated check valve. A carefully shaped poppet stem with a good tapered characteristic offers very little hammer or shock during the change. Secondly, the speed at which the check valve is opened and closed is controllable allowing a degree of deceleration. This is accomplished by orificing the pilot line to operate the check valve.

CIRCUIT WITH CAM-OPERATED VALVE

The circuit using a 2-way, cam-operated valve is widely used for applications where one feed rate is required. The cam-operated, 2-way valve is a normally open valve with integral check. A pressure-compensated flow control valve connected in parallel is sized by the maximum metered flow. The change from rapid advance into feed is smooth if a good tapered spool is incorporated in the cam valve. A long taper will provide a good deceleration. Low feed rates may be erratic because of the clearance leakage across the cam-operated, spool-type valve.

The advantage of this circuit is the reliability of the mechanical actuator which governs the speeds. A sticking solenoid-operated, spool-type valve prevents transition into feed and plunges the tools into the work.

One disadvantage of the circuit is that it usually presents complicated and messy piping around the machine as compared to the four lines leading to a feed panel and from the panel to the cylinder connections.

To modify the circuit to a 2-feed unit is rather difficult. A 3-position, cam-operated valve is required. Most standard, close fitting, cam-operated valves are 2-position, 2-way, spring off-set. A special 4-way valve must be devised with long stroke tapers and the necessary third position. In contrast, the cam-operated feed panel is normally a 2-feed unit. It can very well be used for single-feed application and still be comparable in price.

On standard valves, the spool travel from one position to another is so short that deceleration or throttling is almost impossible. As a result, the action would be jumpy. ▼▼▼

THIRD PRIZE

Conrad R. Himmler

HYDRAULIC POSITION SERVOS

.design and application

● Construction and performance data on some French-developed servo systems

HYDRAULIC servo position controls may be divided into two broad groups, valve servos and pump servos. As these designations imply, valve servos are designed around a servo valve while pump servos employ a servo pump. In either case, both volume and direction of fluid flow to the output device, or actuator, are varied in response to an input signal to give a proportional output with power amplification.

● **Rotary-Valve Servo**—A valve servo whose input and output are both rotary is shown in Figure 1. Since both input and output are torques, and the input is an extremely low torque while the output

FIG. 1. Unit valve servo incorporates valve, rotary motor, and feedback system. Maximum output torque is 10 kg-m. Useful speed range is from 0.1 to 600 rpm.

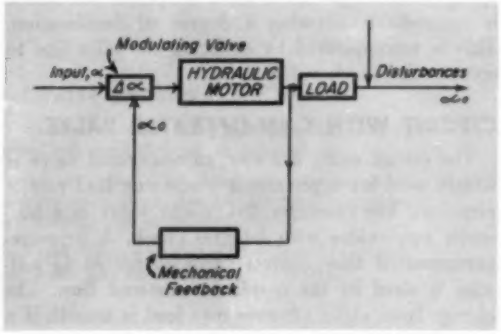


FIG. 2. Block diagram of the unit valve servo, or torque amplifier.

is the high torque of a radial-piston motor, this servo might be called a torque amplifier. In addition to the valve and motor, the feedback system is also an integral part of the unit. Feedback is provided by rotation of a sleeve which incorporates the valve orifices. The sleeve is driven by the motor so that when the motor reaches the angular position corresponding to position of the valve, valve orifices are closed to hold the motor in that position. Valve rotation may be manual or may be done with a small electric or hydraulic motor. A block diagram of the torque amplifier is shown in Figure 2. Figure 3 is a circuit diagram of the hydraulic motor-controlled torque amplifier.

This type of construction results in high sensitivity by eliminating backlash in the feedback system and high response rate because the volume of oil trapped between the valve and the motor is small. By keeping this volume small, there is little change in bulk modulus due to compressibility and the servo is, therefore, quite "stiff." Because of this high sensitivity, the servo will respond to an input movement as small as 0.25 deg. Response of the servo to a sudden change in input is shown in Figure 4.

In this servo, the following error varies with the output torque requirement, Figure 5, as well as with speed. Although speed remains constant, the phase error changes.

Response to a simple harmonic input is shown in Figure 6. As frequency increases, amplification is fairly constant until a critical frequency is reached. Then, as frequency increases, it becomes more difficult for the servo to follow and amplification goes to zero. Phase lag is linear with increasing frequency for a certain range and then it increases sharply.

• **Electrical Feedback System**—For some applications the input of the torque amplifier may be actuated by a hydraulic motor which is controlled by an electrical feedback from the load. Diagram of such a system is shown in Figure 7. In this system, the motor would be controlled by an electro-hydraulic servo valve as diagrammed in

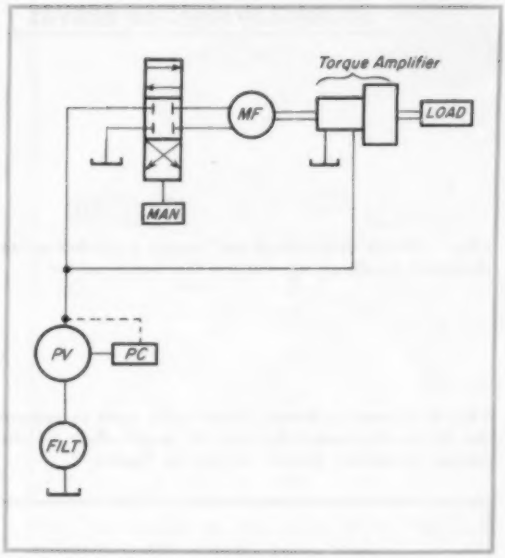


FIG. 3. Circuit diagram of the hydraulic motor-controlled torque amplifier.

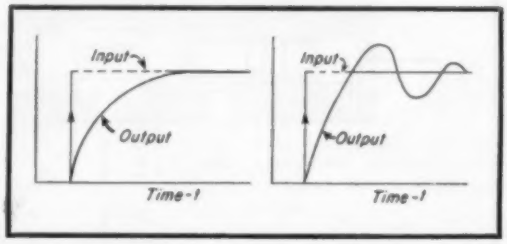


FIG. 4. Response of the torque amplifier to a sudden change in input. Left-hand curve shows response of the system when heavily loaded or highly damped. Curve at the right is for light load or little damping.

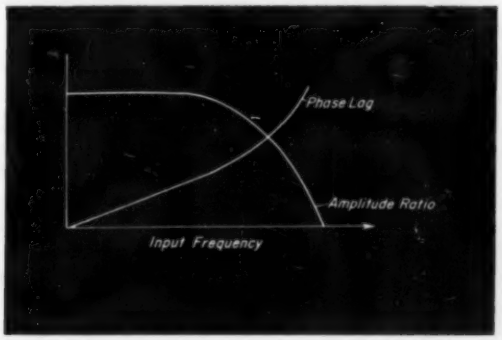
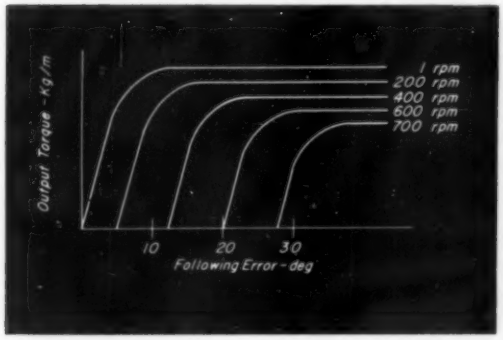


FIG. 5. Following error vs. torque output curves for the torque amplifier show that error increases as speed increases.

FIG. 6. Curves of amplitude ratio and phase lag versus input frequency.



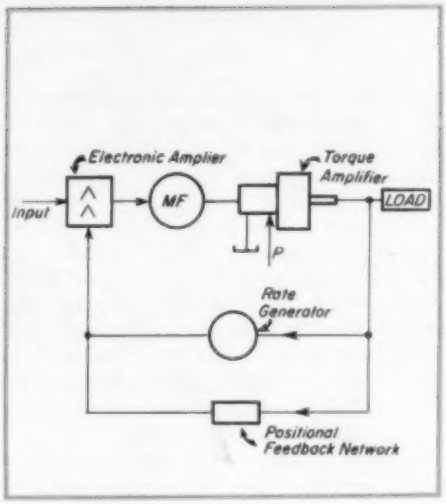


FIG. 7. Block diagram of the torque amplifier using electrical feedback to control the input motor.

FIG. 8. Electro-hydraulic servo valve used to control the hydraulic motor driving the input shaft of the torque amplifier system shown in Figure 7.

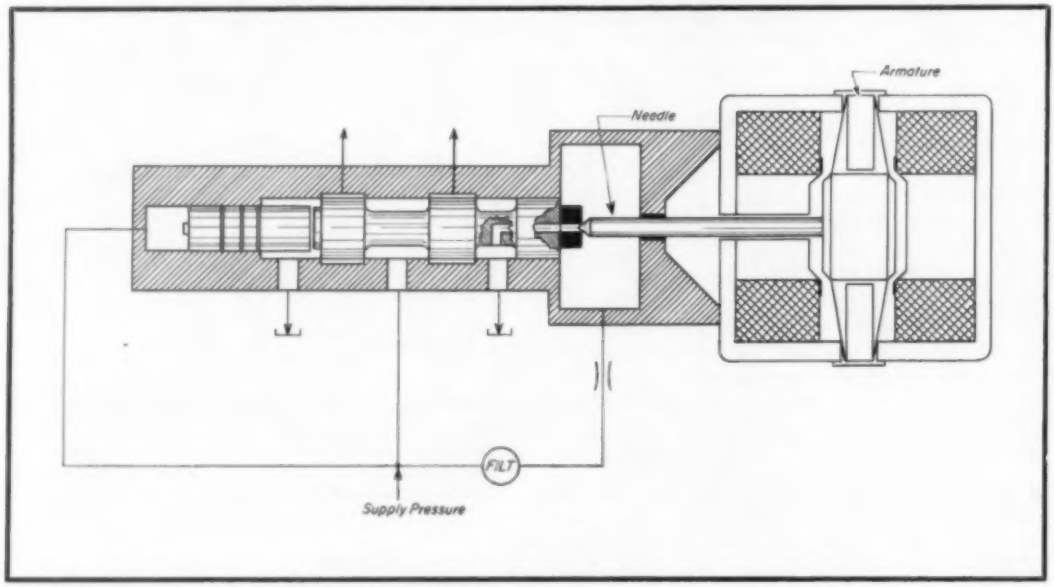


Figure 8. In this valve, an electrical signal applied to the armature moves a needle valve to vary pressure on the right end of the main valve spool. Full supply pressure is applied to the left end of the spool but acts against an area which is only half that of the right end. A restriction in the line to the needle valve chamber limits the controlled pressure to a minimum value of 0.3 times supply pressure. Maximum pressure on the right end of the main valve spool is limited to 0.7 times supply pressure by leakage.

Performance tests on the servo valve show that flow vs. armature current is nearly linear for both flow directions with practically no dead space, Figure 9. Pressure in the needle-valve chamber varies about 40 kg per square centimeter per 0.01 mm of spool movement. Rate of flow variation for the valve is 60 cu cm per sec per milliampere of control current at a supply pressure of 200 kg per sq cm. Magnitude of the transfer function of the valve starts to fall off at 80 cps for 10% power output.

• **Pump Servo**—In a pump servo, oil from the pump outlet is fed directly to the motor, Figure 10. Pump output is controlled by an electro-hydraulic position system which controls the tilt angle of the cylinder block of the axial piston-type pump.

For a typical pump servo of this type developed at the Centre de Recherches Hydraulic (CRH), leakage affects the output speed of the motor as load torque increases as shown in Figure 11, when pump displacement and speed are constant. These curves are for a motor with displacement of 200 cu cm per rev and a pump with delivery of 120 liters per min. Other performance figures for this

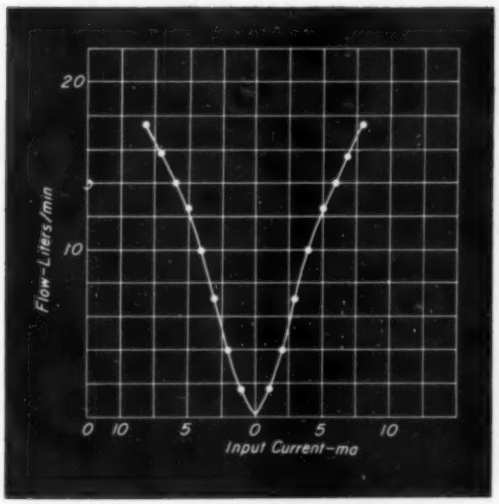


FIG. 9. Flow vs. input current of the electro-hydraulic servo valve.

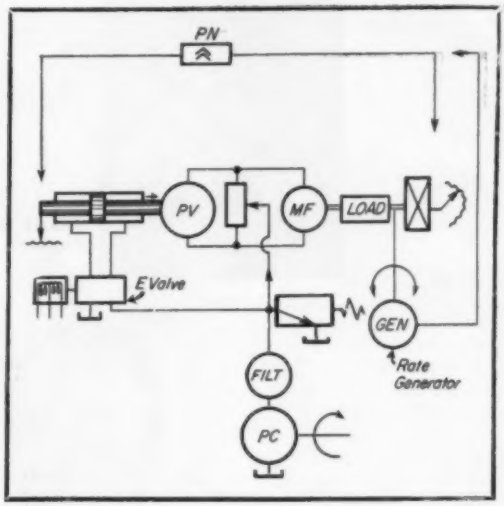


FIG. 10. Circuit of the pump servo. An electro-hydraulic system controls pump stroke.

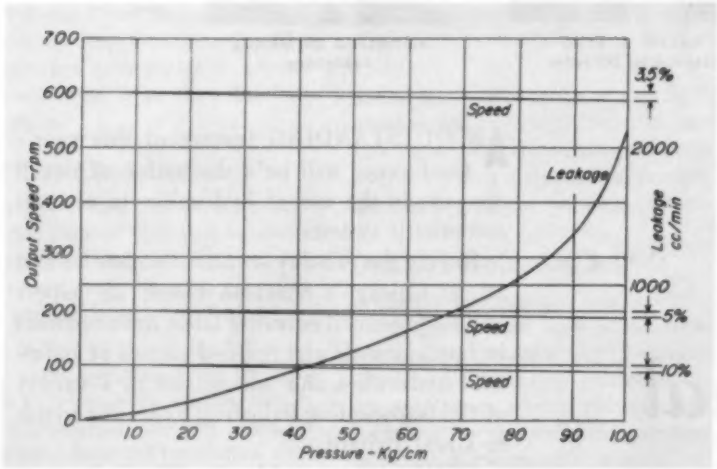


FIG. 11. Leakage and output speed vs. pressure (load torque) for a CRH pump servo.

servo are: 20 hp; maximum pressure, 150 kg per sq cm; acceleration, 1.25 x 10^2 rad per sec per sec; time constant, 0.005 sec; motor inertia, 40 x 10^{-4} kg-m per sec per sec; sensitivity, 0.2 ma; frequency at 50% load, 10 cps.

● **System Comparison**—Since, in the valve servo, flow control is achieved at the expense of pressure drop across the valve, it would seem that losses in this system might be excessive. Actually, this is not the case in a position-control system because the valve is closed most of the time. Use of a pressure-compensated pump, which is the usual procedure, reduces losses during idle time to a minimum. Another point to consider is that a single, pump might be used to operate several valve servos, while each pump servo must have a separate pump.

Pump servos can provide higher acceleration rates than valve servos. This is particularly true at high speeds. As was pointed out previously, speed of pump servos decreases as load increases. Speed of the valve servo is more independent of load torque.

Response time, time constant and velocity range are usually better for the valve servo because of the reduced effect of compressibility in these circuits. Low mass and inertia of the moving system in the valve servo also contribute to high performance.

Weight of the pump servo will usually be less than that of the valve servo when only a single function is being performed. However, as pointed out previously, the pump in a valve-servo system may be used to supply other valve servos. This means a definite weight advantage for valve servos when more than one function is to be performed. ▼▼▼

FRANK. D. CARVIN
Director

RALPH J. KING
Associate Director

RAYMOND D. MEADE
Secretary

13th National Conference Industrial · Hydraulics

AN OUTSTANDING feature of this year's Conference will be a discussion of developments in the use of hydraulics in aircraft and missile systems.

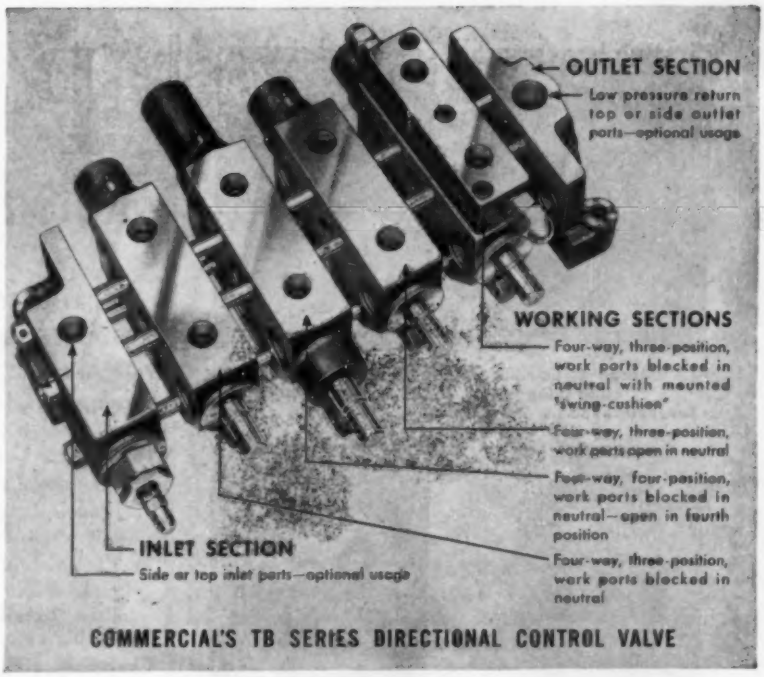
During the two-day session, October 17 and 18, at Chicago's Sherman Hotel, 22 papers will be presented covering latest developments in fundamentals and applied phases of industrial hydraulics and pneumatics in a variety of fields, including industrial hydraulic trends in Great Britain.

NCIH is sponsored by the Illinois Institute of Technology and its affiliate Armour Research Foundation, in cooperation with several engineering societies and more than 100 industrial organizations. Starting in 1945, the Conference has kept pace with the rapid growth of the fluid power field, and is now the focal point for the exchange of the latest information on developments in this field.

Director of this year's Conference is Frank D. Carvin, Director of the Department of Mechanical Engineering of Illinois Tech. Associate Director is Ralph J. King, Staff Engineer of Caterpillar Tractor Co. Raymond D. Meade of Illinois Tech is Conference Secretary.

Abstracts of papers to be presented, given on the following pages, give brief but valuable information for those unable to attend.

NEW DESIGN IN FLUID POWER CONTROL VALVES


OUTLET SECTION
Low pressure return top or side outlet ports—optional usage
WORKING SECTIONS
Four-way, three-position, work ports blocked in neutral with mounted "swing-cushion"
Four-way, three-position, work ports open in neutral
Four-way, four-position, work ports blocked in neutral—open in fourth position
Four-way, three-position, work ports blocked in neutral
INLET SECTION
Side or top inlet ports—optional usage
COMMERCIAL'S TB SERIES DIRECTIONAL CONTROL VALVE

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The higher the back pressure in a control valve the greater the power loss and the less efficient the fluid power system.

Advance design in Commercial's control valves—larger circulatory passageways, more uniform cross sections, smoother wall surfaces, and freedom from abrupt direction changes—lowers internal pressure drop as much as 15%.

Commercial valve performance is increased because flow around large outside surfaces of solid spools is unimpeded—not forced through constricting orifices. And Commercial's valve passageways have equal or greater cross-sectional area than inlet or work ports.

Load Drop Eliminated

Pressurized return flow in many conventional control valves frequently results in erratic operation—sudden movements and one load dropping while another is being positioned.

An individual check, located so as not to cause any passageway constriction, is built into every working section of a Commercial control valve. It blocks all pressurized return flow until it is overcome by pressure build-up from the pump—makes for safe, smooth, precise and accident-free operation.

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Because of structural design weaknesses in many control valves optimum operation at pressures up to 2000 psi is often not practical or even possible.

With Commercial's control valves operation at pressures up to 2000 psi is recommended. The non-porous grain structure of the high-strength, semi-steel castings used in Commercial's valve sections prevents seepage of pressurized oil. And because of their greater strength the section castings do not distort when stressed under pressure.

The use of O-rings—instead of gaskets—for all sealing between sections and at the ends of spools assures leakproof operation. Elimination of gaskets between sections also precludes overstress and distortion of section castings to prevent possible leakage.

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A combination overload relief-pressure valve—incorporated right in the housing of Commercial's control valves—provides positive safety protection for the fluid power system, plus overload protection for the structural members and tools of the machine in operation. Its complete cartridge construction permits easy removal from the inlet section of the valve bank—for quick inspection or replacement.

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Commercial's control valves involve parallel circuit operation—provide pressure to two or more operations simultaneously when so desired. Working sections having three-way, three-position; four-way, three-position; and four-way, four-position actions, are available and can be assembled independently in any combination or sequence.

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- ☐ Oil-Hydraulic Pumps and Motors, Catalog H-4
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Aircraft Systems

Joseph J. Siemer
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Pneumatics

Francis B. Levetus
"Industrial Hydraulic
Trends in Great Britain"

PROG

NATIONAL CONFERENCE ON

THURSDAY, OCTOBER 17, 1957

8:00 A. M. Registration: Sherman Hotel, Chicago

9:00 A. M. GENERAL SESSION

Opening: Frank D. Carvin, Director, Department of Mechanical Engineering, Illinois Institute of Technology, Conference Director.

1) "Industrial Hydraulic Trends in Great Britain", Francis B. Levetus, Technical Director, Keelavite Co., Ltd., Allesley, Coventry, England.
2) Presentation of awards to winners of APPLIED HYDRAULICS 1957 PRIZE PAPER CONTEST by Paul Rolnick, Editor, Industrial Publishing Corporation, Cleveland.

Chairman: Ralph J. King, Staff Engineer, Caterpillar Tractor Co., Associate Conference Director. "Use of Digital Computers in the Design and Manufacture of Hydraulic Equipment".

1) "An Introduction to Digital Computers", Leonard W. Swanson, Arthur Anderson & Co., Chicago.
2) "Use of Digital Computers to Design Hydraulic Components and Circuits", Leslie Knutson, Remington-Rand Univac, St. Paul.
3) "Solution of Manufacturing Problems Using Digital Computers", C. W. Swift, Branch Manager, Applied Science, International Business Machines Corp., Chicago.

12:15 P. M. LUNCHEON

2:00 P.M. AFTERNOON TECHNICAL SESSIONS
(all held simultaneously)

Aircraft Systems

Chairman: B. R. Teree, Vice President, Greer Hydraulics, Inc.

1) "Development of High Temperature Hydraulic Systems For Aircraft", F. H. Pollard, Asst. Chief Hydraulic Engineer, Republic Aviation Corp., New York.
2) "A Rational Approach to the Endurance Testing of Flight Control Components", George R. Keller, Engineer Group Leader, and L. W. Strobel, Senior Engineer, Research, Autonetics Corp., Downey, Calif.
3) "An Unsophisticated Electronic Analog Simulation of an Hydraulic Powered Pumping System", Alfred B. Herren, Mechanical Equipment Staff, Beoing Airplane Co., Wichita.

Automatic Machine Tools

Chairman: Ernest Wiedmann, Chief Engineer, The Oilgear Co.

R A M

INDUSTRIAL HYDRAULICS

1) "A Machine Tool Servo Valve Application", Leonard Hesse, Development Engineer, Gisholt Machine Co., Madison.
2) "Electro-Hydraulic Pump Strokers for Versatile Open-Loop Hydraulic Circuitry", Norbert Nitka, Engineering Dept., The Oilgear Co., Milwaukee.

Mobile Equipment

Chairman: V. P. Donner, Chief Engineer, Hydraulics, International Harvester Co., Melrose Park Works, Chicago.

1) "Hydraulic Steering System of a Two-Wheel Tractor", T. E. Hrodey, Supervisor, Caterpillar Tractor Co., Peoria.
2) "LeTourneau-Westinghouse Hydair Suspension", Ralph H. Kress, Manager, Truck Division, LeTourneau-Westinghouse Co., Peoria.

Servomechanisms and Systems

Chairman: Duncan B. Gardiner, Director of Research and Development, Vickers Incorporated.

1) "Servo-Controlled Simulator for Measuring Vehicle Ride and Roll Characteristics", Robert W. Graham, Engineer, Research and Development Section, and Edward K. Benda, Engineer. Laboratory Instrumentation Dept., Chevrolet Motor Division of General Motors.
2) "Application of Non-Linear Techniques to On-Off Servomechanisms", Michael B. Scherba, Associate Professor, Electrical Engineering Dept., Wayne State University, and Anthony Gregory, Instructor, Aeronautical Engineering Dept., University of Michigan.

6:30 P. M. ALL SOCIETY BANQUET
Speaker: Brig. Gen. Franklin M. Kreml, Director, Transportation Center, Northwestern University.

FRIDAY, OCTOBER 18

9:00 A. M. MORNING TECHNICAL SESSIONS
(all held simultaneously)

Automotive

Chairman: F. L. Mackin, Chairman, Machine and Wood Shops and Hydraulics, General Motors Institute.

1) "An Analysis of Fuel Injection for Passenger Cars", Don Stoltman, Staff Engineer, Rochester Products Div., General Motors Corporation, Rochester.
2) "Hydraulic Servo Gives Constant Speed for Automotive Accessories", F. N. Beauvais, Section Supervisor, and W. J. Payne, Research Engineer, Automotive Research Dept., Engineering Research, Ford Motor Company.

Hydraulic Fluids

Chairman: Robert Q. Sharpe, Chief Engineer, Industrial Socony-Mobil Oil Co., Inc.

1) "A Summary of Methods for Measuring Fluid Viscosities and Compressibilities at High Pressures", Rex T. Ellington, Asst. Research Director, and Bertram E. Eakin, Supervisor of Reservoir Engineering Research, Institute of Gas Technology, Chicago.
2) "Fluid Properties and Hydraulic Design", R. L. Leslie, Fluids Research Dept., Vickers Incorporated, Detroit.

Presses

Chairman: Melvin G. Sulser, Regional Manager, Denison Engineering Div., American Brake Shoe Co.

"Meeting Today's Problems With Today's Presses", a symposium led by Profs. O. D. Lascoe and B. E. Quinn, Dept. of Mechanical Engineering, Purdue University. Panelists representing the following manufacturers: Verson Allsteel Press Co., Clearing Machine Co., Oliver Corporation, Hydraulic Press Manufacturing Co., Watson-Stillman Co.

12:15 P. M. LUNCHEON

2:00 P. M. AFTERNOON TECHNICAL SESSIONS
(all held simultaneously)

COMPONENTS AND ACCESSORIES

Chairman: John T. Ellis, Chief Engineer, Hanna Engineering Works.

1) "Fluid Leakage KO'd", G. T. Lyon, President, L & L Manufacturing Co., Detroit.
2) "Application of Electro-Hydraulic Servo Valves to Industrial Control", Bernard A. Johnson, Project Engineer, Cook Research Laboratories, Chicago.

Pneumatics

Chairman: Joseph J. Slomer, Hydraulic Engineer, Goodman Manufacturing Co.

1) "New Design Concepts for High Pressure Pneumatics Systems", T. H. Chadwick, Senior Design Group Engineer, and Paul L. Brady, Design Group Engineer, Convair, San Diego.
2) "Testing of High Pressure Pneumatic Components", Leonard L. Baker, Managing Engineer, Mechanical Laboratory, Chrysler Missile Operations, Chrysler Corporation, Detroit.

Pumps

Chairman: Robert B. Banks, Chairman, Dept. of Civil Engineering, Northwestern Technological Institute.

1) "A Review of the Fundamentals of Positive-Displacement Pumps and Motors", R. C. Binder, Prof. Mechanical Engineering, Purdue University.
2) "Development and Application of Centrifugal Pumps Die-Casting Service", Thomas E. Hall Administrative Engineer, Byron Jackson Div., Borg-Warner Corporation, Los Angeles.

These abstracts were written by speakers at the NCIH for quick reference. Complete Conference Proceedings will be published in a bound volume early in 1958.

summaries of

TECHNICAL PAPERS

presented at the 13th NCIH

GENERAL SESSION

• USE OF DIGITAL COMPUTERS IN DESIGN OF HYDRAULIC CIRCUITS & COMPONENTS

by Leslie E. Knutson, Management Services & Operations Research, Remington Rand Univac.

An introduction to use of digital computers in design of hydraulic equipment. Illustrations will use three types of hydraulic systems and their basic problems. This will include transfer operations, hoists and hydraulic transmission variables of weight, space, cost, flow, viscosity and pump design and dependability. By use of basic problems and a sufficient number of variables, it will be shown that digital computers can be used effectively in hydraulic design.

• SOLUTIONS OF MANUFACTURING PROBLEMS ON DIGITAL COMPUTERS

by C. W. Swift, Branch Manager, Applied Science, International Business Machines Corp.,

Discussion of manufacturing problems such as material requirements and product performance solved by use of digital computers. Approaches usually fall into one of two categories. Either physical requirements are provided, and the computer is used to design some part of the product; or a mathematical model is constructed, simulating actual product performance, and parameters are varied until performance meets requirements. Normal practice uses both approaches prior to actual production. Some of the methods involved in these approaches will be discussed with respect to their application on electronic digital computers.

AIRCRAFT SYSTEMS

• DEVELOPMENT OF HIGH TEMPERATURE HYDRAULIC SYSTEMS FOR AIRCRAFT

by F. H. Pollard, Assistant Chief Hydraulic Engineer, Republic Aviation Corporation.

Points out several causes for increased temperature levels. Specification MIL-H-5440, which governs the design of aircraft hydraulic systems, now recognizes maximum temperature levels of 160, 275 and 400 F, but even higher temperatures are

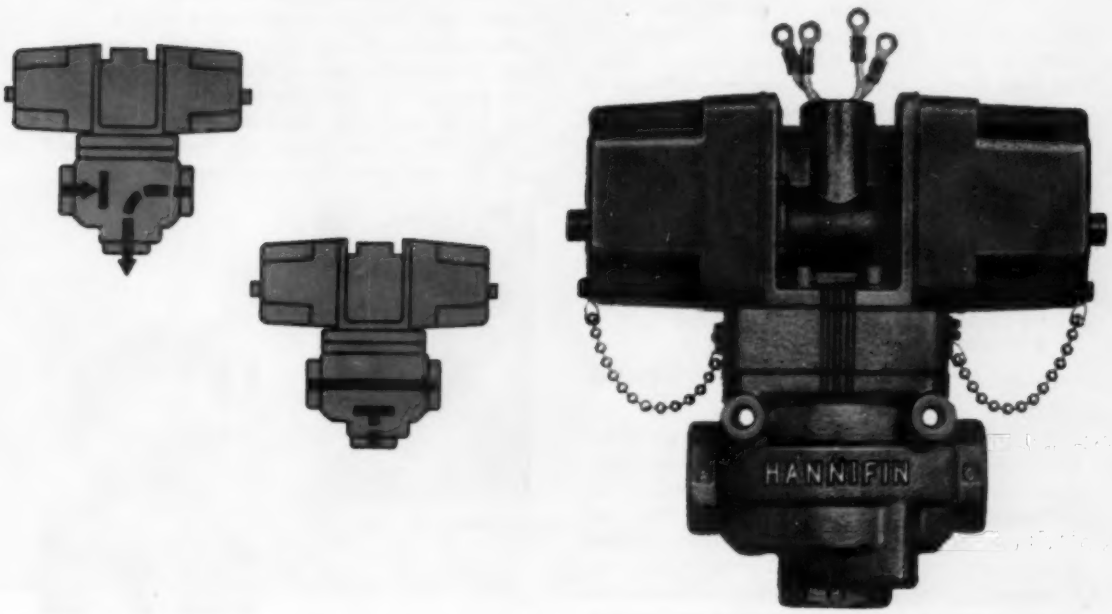
F. H. Pollard

George R. Keller

being studied. Above the 400 F point, there are no definite classes, but the maximum usable temperatures of the synthetic fluids tend to describe other ranges. This paper covers problems in fluids and packings and reviews developments such as the Air Force and Navy Bureau of Aeronautics development contracts for various high temperature valves and other components, and components developed by equipment manufacturers on their own or under contracts from airframe manufacturers.

Setting the pace for automation

...Hannifin valves



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• A RATIONAL APPROACH TO THE ENDURANCE TESTING OF FLIGHT CONTROL COMPONENTS

by George R. Keller, Engineer Group Leader, and L. William Strobel, Senior Engineer, Research.

Describes a method of multiplying the statistical description of gustiness by the transfer function of the airframe-autopilot to obtain a statistical description of response of controlling elements. Applying proper filtration to output of a random noise generator provides a signal with the same statistical nature as the stabilizing motions of the controlling elements. If simulated programmed maneuvers, and long-period oscillations are super-imposed on the filtered random signal, testing signal generated is a good model of flight activity. Testing can then be accomplished in terms of simulated flight hours, rather than in numbers of arbitrary cycles.

• AN UNSOPHISTICATED ELECTRONIC ANALOG SIMULATION OF A HYDRAULIC-POWERED PUMPING SYSTEM

by Alfred B. Herren, Boeing Aviation Co., Wichita Division.

Approach taken in simulation of an airborne hydraulic system is outlined. System is simulated component-by-component, modular fashion, and real dimensional quantities are used. Thus the study has the character of a laboratory investigation rather than a more sophisticated and abstract analysis. Charts will be presented illustrating functional relationships among governing equations and components. System behavior indicated by simulation will be described and results of certain parameter changes shown. As a result of this study, a component is redesigned and the effects of the redesign on the system performance are presented.

AUTOMATIC MACHINE TOOLS

• ELECTRO-HYDRAULIC PUMP STROKERS FOR VERSATILE OPEN-LOOP HYDRAULIC CIRCUITRY

by Norbert Nitka, Engineer, The Oilgear Company.

Fundamentals of electrical circuiting for the electrohydraulically stroked pump are covered by analyzing six particular circuits, each having some special function included in the electrical circuits. Included are: a simple laboratory press circuit with special switching interlock, a milling machine with six adjustable speeds, an extrusion press with two pumps stroking identically over 12 preset speeds, a grinder circuit with equal forward and reverse speeds set on a single dial, a flying cut-off with electrical tachometer to readjust average speed with main drive speed, and an extrusion press with a single dial to bring in four pumps in sequence.

• A MACHINE TOOL SERVO VALVE APPLICATION

by Leonard Hesse, Development Engineer, Gisholt Machine Company.

Problems in applying servo valves to a machine tool will be discussed. Material is based on experimental work being done at Gisholt with a turret lathe controlled by information stored on magnetic tape. Slides will be shown illustrating the machine and components of specific interest. Also included will be an interesting application of the hydraulic JE tracer, which is strictly a hydraulic servo, and uses no electrical or electronic controls.

Leonard Hesse

T. E. Hrodey

MOBILE EQUIPMENT

• HYDRAULIC STEERING OF A TWO-WHEEL TRACTOR

by T. E. Hrodey, Supervisor, Caterpiller Tractor Co.

Problems of steering rubber-tired tractors used in earthmoving are discussed, and features of the hydraulic steering system of the Caterpillar "DW21" are described. These include: Steering control supplies fluid pressure only when the steering wheel is being turned. Two pairs of cylinders work simultaneously for 90° turns in either direction. Steering control, actuated by the steering wheel, changes rate of fluid flow to the speed at which the wheel is turned, so the faster the operator turns the wheel, the faster the rate of turn. Oil is supplied by a double pump raising pressure only when required. Follow-up system actuates the hydraulic system to counteract road shock and maintain straight ahead travel.

Circle 124 →

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• LeTOURNEAU-WESTINGHOUSE "HYDRAIR" SUSPENSION

by Ralph H. Kress, Manager, Truck Division, LeTourneau-Westinghouse Company.

Features of the "Hydrair" suspension, providing stability for fast travel over uneven terrain, will be discussed. Each wheel suspension unit consists of only two parts: a stationary cylinder secured to the frame, and a moving, flanged head piston secured to and operating with each wheel. The large compression chamber above the piston head contains a layer of oil for lubrication with the area above it filled with compressed dry nitrogen. Below the piston head and at its outer circumference is a circular chamber filled with oil. A control at base of piston rates oil flow from the circular chamber to the interior of the piston.

SERVOMECHANISMS AND SYSTEMS

• SERVO CONTROLLED SIMULATOR FOR MEASURING AUTOMOTIVE VEHICLE RIDE AND ROLL CHARACTERISTICS

by Robert W. Graham, Engineer, Research and Development Section, and Edward K. Benda, Engineer, Laboratory Instrumentation Section, Chevrolet Motor Division, General Motors.

Covers previous difficulties in comparing load deflection characteristics of one car with another and describes the Chevrolet method. The ride rate machine developd in Chevrolet Engineering Research Laboratory, was designed to use servo-controlled hydraulic cylinders to provide the stroking force. Command signals emanate from a hand-controlled potentiometer or a generator producing sine waves. The servo valves controlling the hydraulic cylinders obtain their signals from power amplifiers driven by a combination of the command signals and correcting feedback signals.

• APPLICATION OF NON-LINEAR TECHNIQUES TO ON-OFF HYDRAULIC SERVO MECHANISMS

by Michael B. Scherba, Associate Professor, Electrical Engineering Department, Wayne State University, and Anthony Gregory, Instructor, Aeronautical Engineering Department, University of Michigan.

Hydraulic servomechanisms employing "on-off" electrically actuated valves are analyzed, using techniques for solution of non-linear systems. Actual system tests described verify results of the analytical analysis. Results are compared to those predicted by describing function and phase plane analysis. Effects of dead band and hysteresis on

Circle 70 on Reader Service Card

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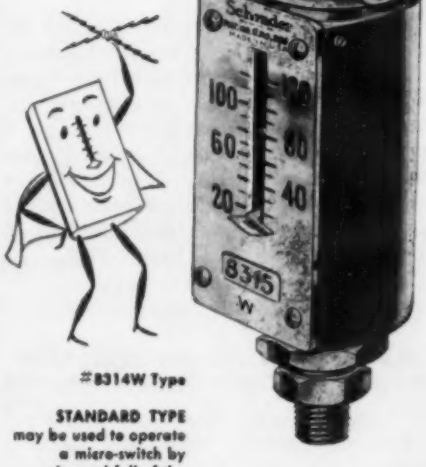
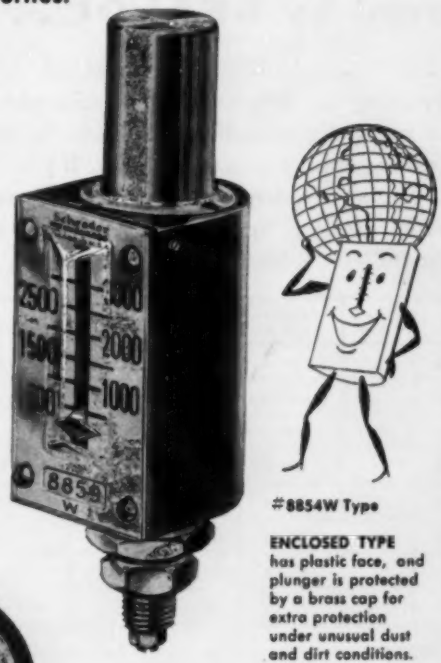


#8314W Type

STANDARD TYPE may be used to operate a micro-switch by rise and fall of the plunger to start another sequence, etc.



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RPM	Shaft Size	Temperature	Fluid	Pressure
36,000	¾"	200° F	Aviation Fuel	300 PSI
1,800	1⅛"	Room Temp.	Uzan Hydraulic Fluid	1500 PSI
11,000	2½"	200° F	Lube Oil	20 PSI
6,800	5"	125° F	Lube Oil	Atmos. Pressure
80	2⅝"	350° F	Steam & Hot Air	Atmos. Pressure
7,700	5¼"	350° F	Lube Oil	2 PSI
53,000	1"	350° F	Oil & Steam	350 PSI
70,000	½"	230° F	Oil Mist & Air	19" Hg. abs.

Slightly modified versions of the basic Sealol seal make it suitable for almost any rotary shaft sealing application.

RPM	Shaft Size	Temperature	Fluid	Pressure
12,000	2¼"	−300° F	Liquid Oxygen	250 PSI
30,000	1⅛"	125° F	90% Hydrogen Peroxide	60 PSI
14,000	1⅜"	160° F	Fuming Nitric Acid	200 PSI
10,000	⅜"	300° F	Propyl Nitrate	150 PSI

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SEALOL

THE BALANCED PRESSURE SEAL

switching are discussed based on experiments with a high performance valve whose dead zone can be adjusted. Advantages of "dual mode" hydraulic systems are also investigated, and an analog computer is used to study effects of parameter variations on system response.

AUTOMOTIVE

• AN ANALYSIS OF FUEL INJECTION FOR PASSENGER CARS

by Don Stoltman, Staff Engineer, Rochester Products Division, General Motors Corporation.

Discusses the meaning of fuel injection, and the difference between fuel injection and spark ignition systems. Unique requirements exist when the engine is applied to passenger cars, because of the expectation that engine performance will produce driver comfort and pleasure. Maximum expected functional improvement of injection over carburetion is another factor. Mr. Stoltman will point out the fundamental problems involved; hydraulically analyze the requirements of such a system; illustrate how various conventional fuel injection systems try to satisfy the conflicting requirements.

• HYDRAULIC SERVO GIVES CONSTANT SPEED FOR AUTOMOTIVE ACCESSORIES

by F. N. Beauvais, Section Supervisor, and W. J. Payne, Research Engineer, Automotive Research Department, Engineering Research, Ford Motor Company.

Design and development of a constant speed accessory drive will be discussed. Unit will operate all accessories at constant speed above a selected design control point. Below control speed, accessories

W. J. Payne

are driven in direct ratio to engine speed with ratios determined by the pulley sizes selected. Transition from direct drive to controlled constant speed is smooth, without clutch or gear ratio change. Unit is a combination gear box and simple hydraulic servo control network providing all required features in one package.

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Fire is a fighting word for the Navy's flattop fleet. In mere minutes it can engulf the biggest carrier. And once it hits the catapults or the deck-edge elevators that lift planes topside for launching, the carrier's striking force is nil.

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HYDRAULIC FLUIDS

• METHODS OF MEASURING FLUID VISCOSITIES AND COMPRESSIBILITIES AT HIGH PRESSURES

by Rex T. Ellington, Asst. Research Director, and Bertram E. Eakin, Supervisor of Reservoir Engineering Research, Institute of Gas Technology.

Presents a brief survey of techniques used to measure viscosity and bulk modulus of fluids at high pressures. Viscometers are categorized according to whether results obtained are absolute or relative. Absolute techniques discussed will be: capillary transpiration, rotating cylinder, rotating plug, and orifice discharge. Relative result methods: falling body, rolling ball, oscillating disk or cylinder, vibrating plate, cone-and-plate or ball-and-cup, and sonic methods. Methods which have been employed to measure fluid compressibility, or bulk modulus, at high pressure are discussed, including bulb and capillary in a balanced-pressure system, fluid confined in a variable-volume container, and Bridgeman's fluid-confined-in-a-bellows technique.

Rex T. Ellington

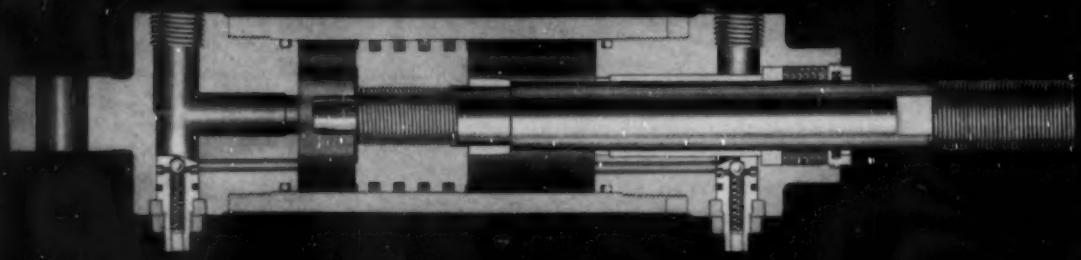
R. L. Leslie

• FLUID PROPERTIES AND HYDRAULIC DESIGN

by R. L. Leslie, Fluids Research Department, Vickers Incorporated.

Covers properties of hydraulic fluids and the effect on design considerations, including viscosity, hydrodynamic lubrication, and fluid with polymeric additives. Also discussed are temperature and pressure changes in density affecting such factors as hydrodynamic lubrication and system response. Expansion of fluids with increasing temperature introduces a "thermal wedge" factor. Wear of moving mating parts in hydraulic components is affected by the lubricating characteristic of the fluids employed. Lubricity of fluid and operating conditions will influence configurations of design and material selection.

Proved in performance



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HYDRAULIC CYLINDERS AIR CYLINDERS HYDRAULIC DIRECTIONAL CONTROL VALVES

COMPONENTS AND ACCESSORIES

● FLUID LEAKAGE KO'D

by G. T. Lyon, President, L & L Manufacturing Company.

Gives recent developments in port geometry and design of port complements. Demands involving high temperatures, high pressures, and at times high frequencies are now commonplace. Also reviews the state of the art today, with a brief discussion of the transition from pipe threads to straight threads. A study will be presented, detailing a similar transition now taking place between O-ring seals and metal-to-metal seals. Concludes that metal-to-metal port sealing, based on proper design, is easily and inexpensively accomplished, permits countless re-assemblies, and allows for any desired fitting orientation.

G. T. Lyon

Bernard A. Johnson

● APPLICATION OF ELECTRO-HYDRAULIC SERVO VALVES TO INDUSTRIAL CONTROL

by Bernard A. Johnson, Project Engineer, Cook Research Laboratories.

Electro-hydraulic control systems with dynamic response capabilities far in excess of those obtainable by any other type of control, have been developed for various military applications. These systems are not only fast, but possess the added advantages of flexibility, extreme ruggedness when operating in adverse environmental conditions, and small size and weight. The component which made this possible is the electro-hydraulic servo valve, which converts low level electrical input signals into high power hydraulic flows and pressures. This paper introduces the servo valve to the industrial designer who is not familiar with it, points out some of the design problems, and discusses industrial applications, present and future.

PNEUMATICS

● NEW DESIGN CONCEPTS FOR HIGH PRESSURE PNEUMATIC SYSTEMS

by T. H. Chadwick, Senior Design Group Engineer, and Paul L. Brady, Design Group Engineer, Convair (San Diego) Division, General Dynamics Corporation.

High pressure pneumatics has a definite place in modern aircraft, particularly where a full power hydraulic control system is used. With high pressure pneumatics as the energy source for utility type functions, the full power system is less vulnerable, thus increasing the overall aircraft reliability. Advantages and applications of various types of circuits, methods of speed control, and snubbing are described in this paper.

T. H. Chadwick

Paul L. Brady

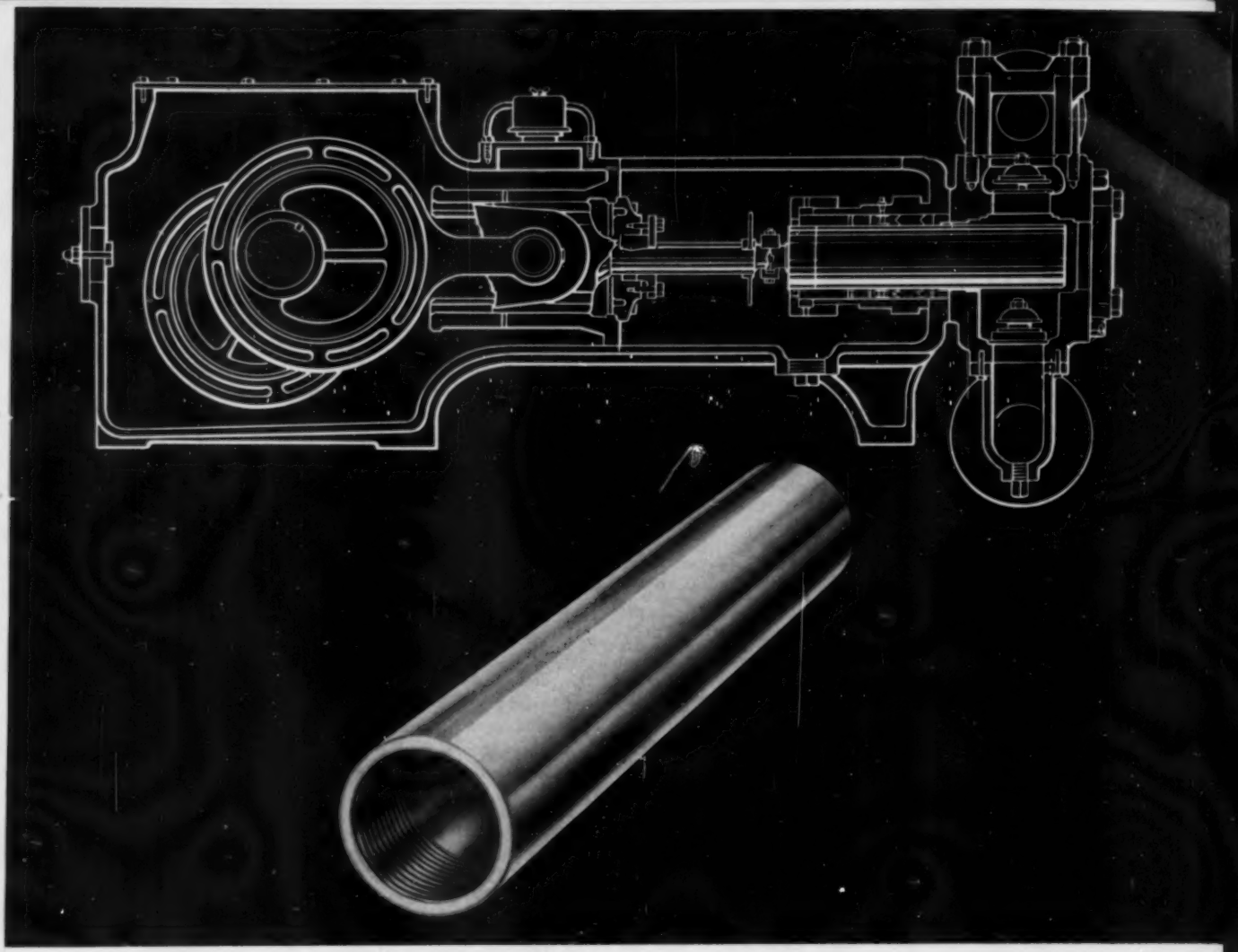
● TESTING OF HIGH PRESSURE PNEUMATIC COMPONENTS

by Leonard L. Baker, Managing Engineer, Mechanical Laboratory, Chrysler Missile Operations, Chrysler Corporation.

Advantages of pneumatics for large ballistic type missile control systems are discussed. High-pressure pneumatics as a means of storing and supplying energy for these controls offers compactness, simplicity, and adaptability to long term storage not readily obtainable with hydraulics. The missile manufacturers must assure reliability and safety by

Leonard L. Baker

Circle 15 ⟶



Reducing Costs With Job Matched Tubing

Does a higher grade tube really cost more? Reduced overall manufacturing cost of pump plungers resulted when one maker switched from tubing made from open hearth processed alloy steel to B&W electric-furnace Alloy Steel Tubing. Rejections on a large production run were reduced drastically (10.75% to 1.25%).

The plunger had to have a very good finish and was to be chrome plated. Jobs like this require high quality and "clean" steel. Because of B&W's melting practices and familiarity with making "clean" steels for bearings and other applications, it was suggested to the fabricator that he consider B&W electric-furnace 8620 Steel Tubing. The use of B&W electric-furnace Alloy Steel drastically reduced rejects on the finished part.

Once again Mr. Tubes proved conclusively that final cost—not initial cost—is the measure of good tube fabricating practice. If you're concerned with costs as well as producing a good finished product, get in touch with Mr. Tubes. He can help you save money. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

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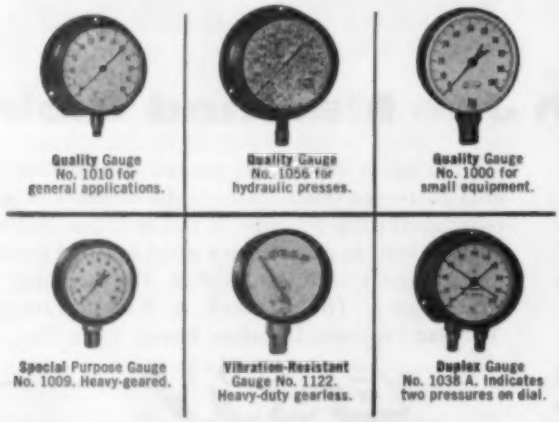

Quality Gauge No. 1010 for general applications.

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SUMMARIES OF NCIH PAPERS

thorough and realistic testing of each component. This testing is only as effective as the operating or inspection procedures, the design of the specialized test equipment, and the training of the test personnel. This paper presents some of the experience gained in the pneumatic component test phase.

PUMPS

● *A REVIEW OF THE FUNDAMENTALS OF POSITIVE-DISPLACEMENT PUMPS AND MOTORS*

by R. C. Binder, Professor of Mechanical Engineering, Purdue University.

This paper focuses attention on rotary machines and discusses such general features as the displacement action and the operating point of a machine. Ideal performance relations are set up, including the volume rate of flow or capacity, torque, and power. Since these performance features involve the displacement per revolution, the ideal displacement is presented for each of the main type pumps and motors, namely: gear, vane, radial-piston, and axial-piston. Actual performance is discussed, including a definition of various efficiencies, and some general performance comparisons. Discussion includes a treatment of cavitation, and the effect of entrained and dissolved air.

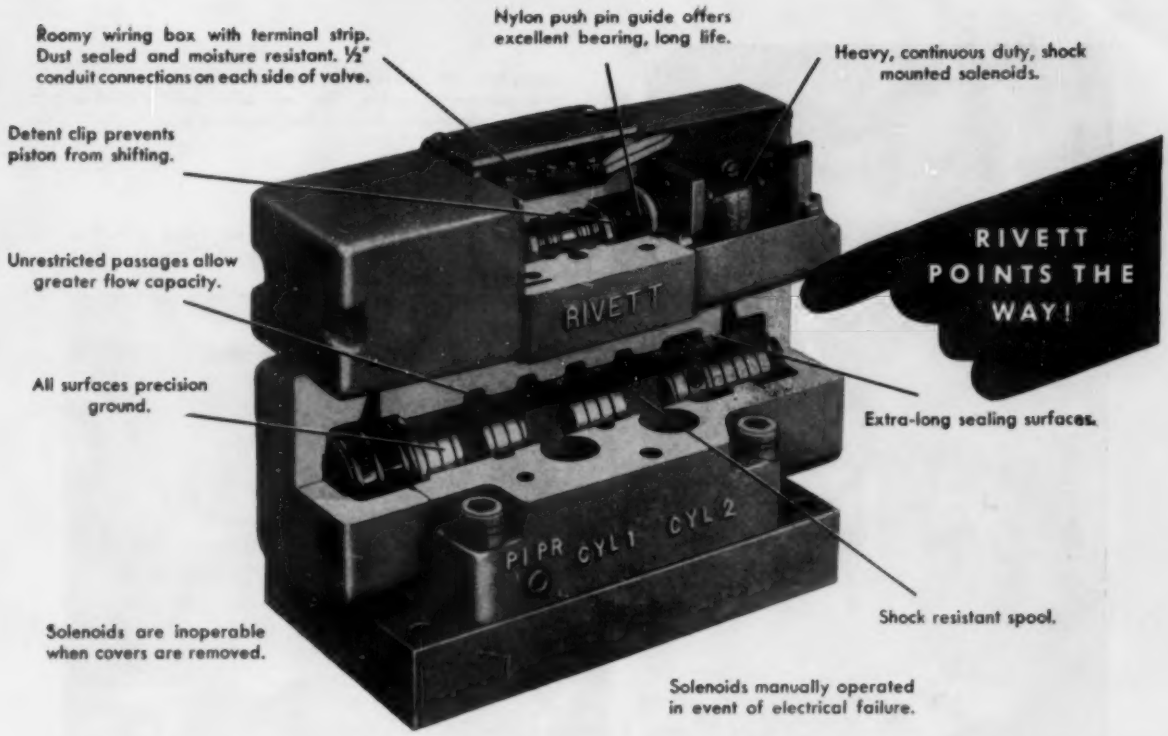
● *DEVELOPMENT AND APPLICATION OF CENTRIFUGAL PUMPS, DIE-CASTING SERVICE*

by Thomas E. Hall, Administrative Engineer, Byron Jackson Division of Borg-Warner Corporation.

This paper discusses the merits of using a centrifugal pump for a central supply of fluid at high pressure and rapidly varying flow rates. Operating arrangements are discussed and suitable types are described, with the basis of design shown to be dependent on proper selection of a good specific speed. Design details are covered, including the use of an outer barrel to contain the developed pressure, use of a vertical unit to eliminate shaft bending, provision for a single stuffing box arrangement under low pressure, space requirements, accessibility of unit for inspection and maintenance, proper selection of materials, and adaptation of mechanical seals for this service.

On the scene . . .

Three APPLIED HYDRAULICS editors will be on the scene to cover proceedings at the NCIH. A report on the design ideas and trends discussed at the conference will appear in the December issue.


Roomy wiring box with terminal strip. Dust sealed and moisture resistant. ½" conduit connections on each side of valve.
Nylon push pin guide offers excellent bearing, long life.
Heavy, continuous duty, shock mounted solenoids.
Detent clip prevents piston from shifting.
RIVETT POINTS THE WAY!
Unrestricted passages allow greater flow capacity.
All surfaces precision ground.
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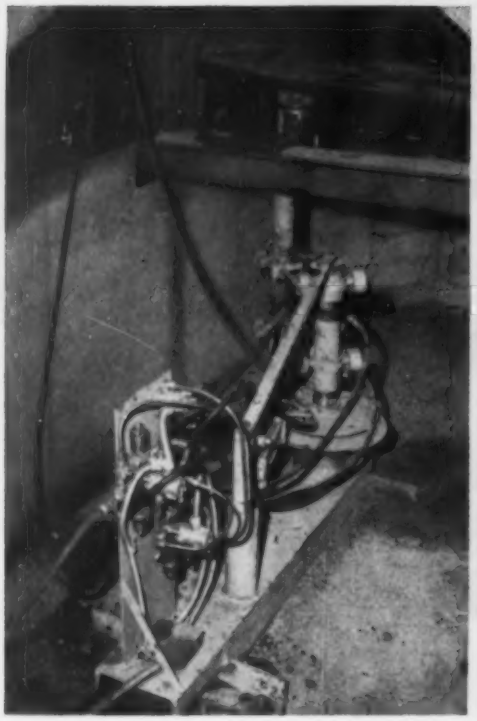
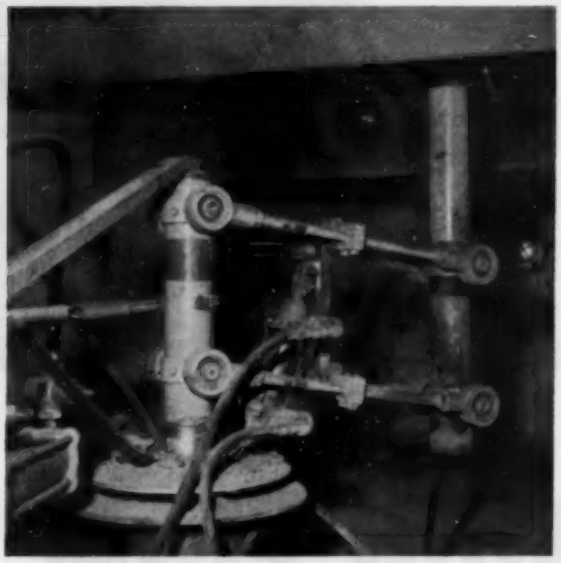


Complete air powered fixture. Solenoid valves control motion of swing, lift and table lock cylinders and an air motor driving the reaming tool.

Closeup of reamer drive. Lift and swing cylinders are seen.



AIR CYLINDER POSITIONED REAMER

. . . improves concrete pipe production

NEED for removal of a feather edge or lip left at the end of a sewer pipe after casting on a vertical pipe making machine resulted in the design of an air powered fixture. This fixture is located in a pit below the pipe making machine to operate in an electrically timed sequence with the pipe making operation. Timing is accomplished by limit switches tripped by cams on the moving head.

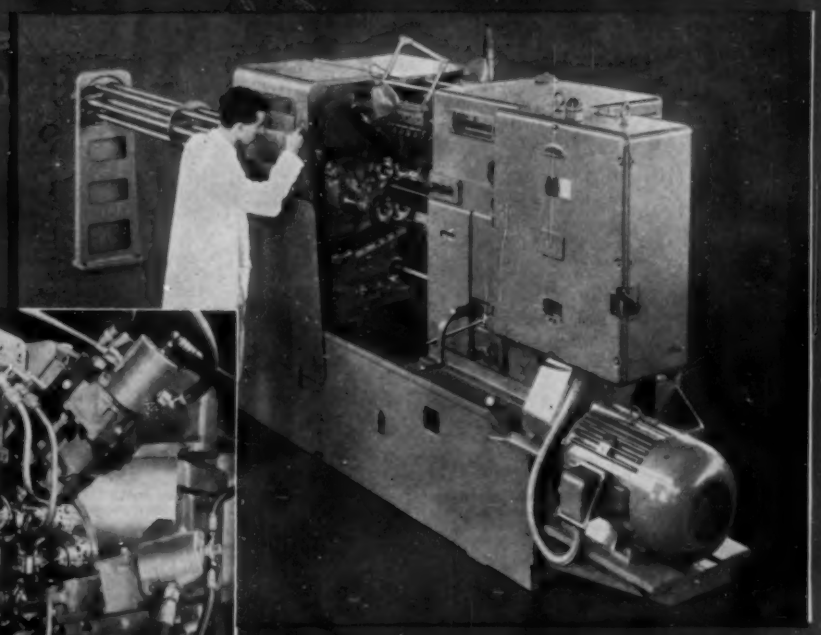
Air is used to lock the rotating machine table—this table has two stations, while pipe is being cast at one, a mold is stripped and a new one set in place at the other station. A second cylinder swings the air motor driven tool into position under the pipe mold, and a third cylinder feeds the simple copper bladed tool up into the mold to cut off the feather edge formed on the finished pipe.

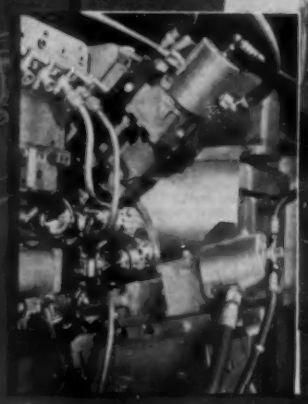
All this effort to remove what looks like a small amount of flash has paid off handsomely. Pipe quality is improved. Scrap which resulted from the previously performed hand reaming, has been virtually eliminated. Finished pipe, carried by fork truck from the machine to a large kiln is stood vertically on end without possible damage caused by breaking away edges.

Air operation of the fixture is fast and safe and stands up well in a dust-laden area. This fixture was designed by Concrete Pipe Ltd. in Toronto for use on the pipe making machines. ▼▼▼

FOR EFFICIENT POWER TRANSMISSION

Keelavite HYDRAULICS





The infinitely variable speed drive drilling attachment provided with this Ransome 7½t Rig Shell Excavator Attachment is driven by Keelavite Hydraulic Motors from a self-contained Power Pack.

A comprehensive standard range of hydraulic power and control equipment backed by circuit design, installation and after-sales service.

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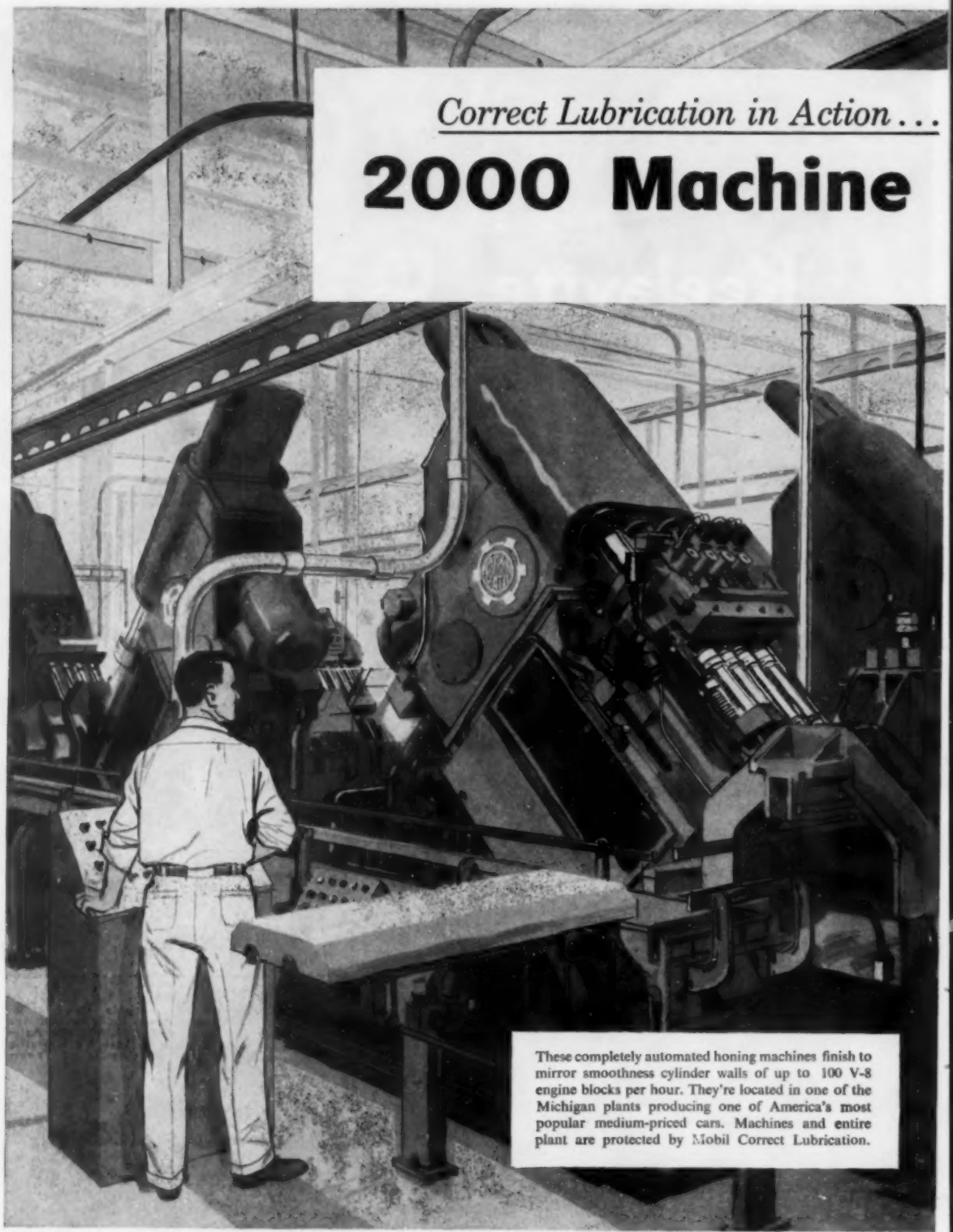
Correct Lubrication in Action . . .

2000 Machine



These completely automated honing machines finish to mirror smoothness cylinder walls of up to 100 V-8 engine blocks per hour. They're located in one of the Michigan plants producing one of America's most popular medium-priced cars. Machines and entire plant are protected by Mobil Correct Lubrication.

Mobil **SOCONY MOBIL**

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Production Hours Saved

6000 REPAIR MAN-HOURS ELIMINATED!

Two of many cost-cutting benefits achieved by this leading automobile company with the help of Socony Mobil

The machines used to produce this automobile company's V-8 engines are so complex and closely interlocked that the failure of one small part may result in the shutdown of an entire production line.

That's why company management recommended the adoption of a planned lubrication program . . . decided on the depth of service offered by Socony Mobil Correct Lubrication. Under this comprehensive program, plant personnel and Mobil engineers coordinated their efforts so effectively that the size and number of maintenance savings have significantly added to company profits.

To cite one example—After surveying 650 hydraulically operated machines in this company's axle and motor plants, Mobil engineers noted use of 8 different hydraulic oils. Their varying performance caused excessive downtime, constant repairs, short oil batch life. Minor machine modifications suggested by Mobil engineers permitted use of a *single* wide-range high quality Mobil hydraulic oil. In just two years, this change made available 2000 additional production hours . . . eliminated 6000 repair man-hours . . . saved 10000 gallons of oil.

* * *

Here's another example of Correct Lubrication in action...proof that it can pay to rely on Socony Mobil.

More Savings—made with the help of Socony Mobil Correct Lubrication

This chart gives some idea of the extent and size of savings achieved through the knowledge, service, facilities and quality products available through Mobil Correct Lubrication.

	Machine Production Hours Saved	Machine Repair Man-Hours Saved	Repair Parts Saving	Savings Period
Hydraulic Systems	2000	6000	Not Recorded	1953-55
Trio Nut Runners	138	276	$1610.	1952-55
Air Wrenches (Motor Assembly)	Not Recorded	188	Not Recorded	1952-55
Bullard Chucks	82	328	Not Recorded	1952-55
Landis Wheel Dresser Bearings	Not Recorded	Not Recorded	87½%	1952-55
Keller Air Hoist	Not Recorded	276	$8970.	1952-55
Ex-Cell-O Cylinder Boring Machines	100	800	$8750.	1952-55

Correct Lubrication

A proved program to reduce equipment maintenance costs

SOCONY MOBIL OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP., MOBIL OVERSEAS OIL CO., INC.

Integral Flow Control Now Available In Larger Volume Vickers Vane Pumps

For power steering of vehicles with very heavy front axle loading

Assures Optimum Steering ...Simplifies and Reduces Cost of Installation

Flow control in hydraulic power steering circuits is necessary because power steering pumps vary in volume delivery according to engine speed. To assure adequate steering power while maneuvering in tight places, the pump must be chosen to provide ample volume at engine idle speed. The much greater flow at high speed, if not controlled, results in unsatisfactory and sometimes unstable steering performance. Further disadvantage is undue heating of the hydraulic fluid.

FIG. 1—Vickers Series V200 Vane Pump with integral flow control and relief valve. Available in 3 sizes with nominal rated capacities of 5, 8 and 11 gpm.* Controlled flow rates of all sizes are 2, 4, 6 and 7 gpm at relief valve setting of 750 or 1000 psi.

***Rating at 1200 rpm.**

An integral flow control valve for limiting flow to the steering device has always been a feature of the small Vickers Vane Type Pumps used in passenger car steering. Excess fluid resulting from higher engine speeds is returned to the reservoir with minimum pressure loss and very little heating. Previously, the larger pumps used for steering heavy vehicles did not have an integral flow control valve. It was installed as a separate unit.

Now Vickers offers larger pumps—the V200 Series—with integral flow control (See Fig. 1), which simplifies and substantially reduces the cost of installation. Smaller hydraulic lines to the steering booster are made possible by limiting flow in this part of the circuit.

For applications requiring two

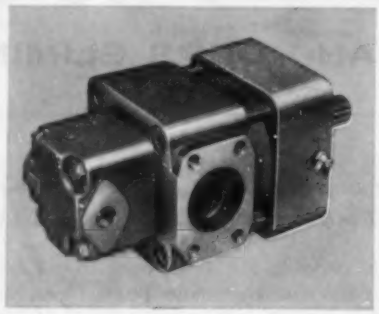

FIG. 2—Vickers Double Pump for operating two independent hydraulic circuits from one power source. Series V2200, V3200 and V4200 are available with the smaller pump (Series V200) having integral flow control for power steering.

separate hydraulic circuits, the Vickers line now includes three new series of double pumps (See Fig. 2). Integral flow control is furnished in the small-volume section used for power steering. The large-volume section, in conjunction with Vickers multiple unit valves is used for operating the vehicle's tools.

Both the single and double pumps with integral flow control have all the features and characteristics responsible for the outstanding popularity of Vickers Vane Type Pumps. Higher efficiency means more work from less power. Hydraulic balance eliminates pressure induced bearing loads, provides longer life and reduced maintenance. Automatic wear compensation maintains "new-pump" efficiency throughout a very long life. Starting in cold weather is easier.

More Vickers designed pumps than all other makes combined are used for hydraulic power steering. Ask for new installation drawings M192680, M192856, M192857, M192858 and #1617-S.

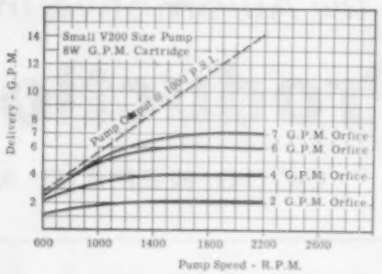

FIG. 3—Typical performance curves of Vickers V200 Pump with Integral Flow Control and 8 gpm cartridge. Delivery rises quickly with speed and then holds at controlled flow rate setting.

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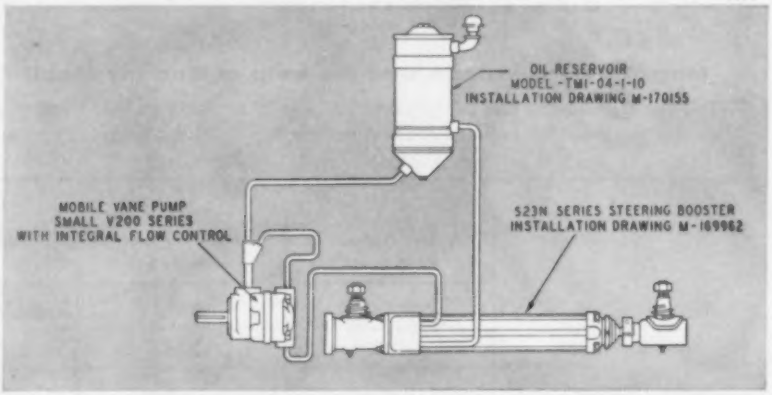

FIG. 4—Preferred circuit when using Vickers Series V200 Vane Pump with integral flow control and Vickers S23N Hydraulic Power Steering Booster. This model is without relief valve because the pump contains such a valve.

VICKERS INCORPORATED

DIVISION OF SPERRY RAND CORPORATION

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MOBILE EQUIPMENT HYDRAULICS

. . . with a portable circuit analyzer

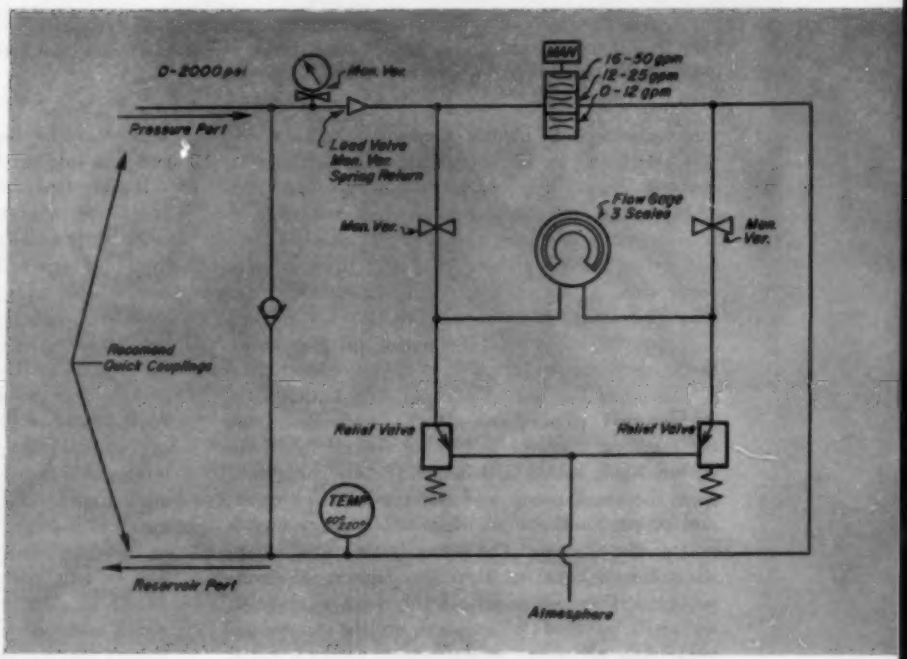

FIG. 1. TESTER uses a throttling valve upstream from three orifices, with a differential pressure gage calibrated in gpm. Check, needle and relief valves guard against error or excessive pressures.

By using a portable hydraulic testing device, trouble-shooting hydraulic systems is made easier. Source of trouble is located on the job before removing any components from the machine, eliminating trips back to the shop to check. This application to a coal cutter is typical of testing on other mobile equipment.

• By John S. Schroeder

FIELD servicing of hydraulic equipment can be more efficiently and rapidly performed with a portable circuit analyzer. Check of system volume at required pressure at various points, quickly indicates locations where operation is inefficient or faulty. This eliminates guesswork as to which component needs replacing, and also points out possible future trouble spots.

• **Analyzer design**—The unit is essentially a throttling valve placed upstream from a set of three orifices, which may be selected for measurement of various flows. From either side of these orifices, a pilot line is brought to a differential pressure

JOHN S. SCHROEDER, *Schroeder Brothers Corp., McKees Rocks, Pa.*

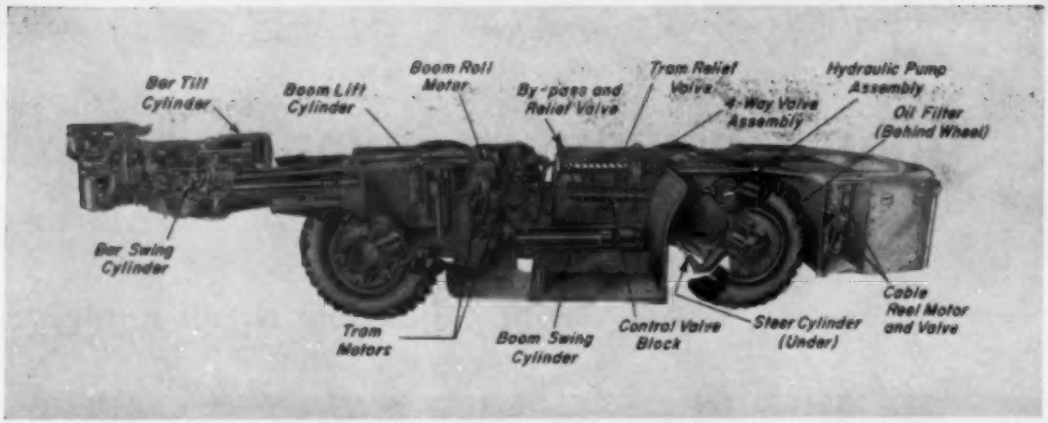

FIG. 2 CHECKING volume at required pressures at points shown will locate any defective components, or indicate that trouble is not in the hydraulic system.

gage calibrated in gallons per minute. Hence, an artificial load can be imposed on flow offered to the test device and resultant flow measured. A thermometer and pressure gage show temperature and incoming pressure. Check valve, needle valves and relief valves protect the unit from reverse connection, wrong choice of orifice, excessive volume, and excessive back pressure.

A description of trouble-shooting on Joy Manufacturing Company's coal cutter, shown in Figure 2, illustrates the use of the portable testing unit.

• **General procedure**—If the complaint from the machine operator is general for all functions, the mechanic would first detach the discharge hose from the small pump and connect it to the tester, and return another hose from the tester reservoir port to the fill pipe. The pump is then started and its volume is read on the flow gage at minimum pressure. Then by means of the tester load valve, an artificial load is imposed on the pump and volumetric efficiency at the higher pressure noted.

If the pump is performing well, the mechanic will then go to the pressure port of the steering valve and repeat the test. If he still gets good results, then he has established that pump, relief, and one side of the steer valve are O.K.

Having determined this, he can repeat the same procedure at each port of the valve block, determining the condition of each spool for each position, and remove the faulty units. If he finds a section not working properly, and knows by testing that he is offering the proper volume at the required pressure, then he can assume the difficulty lies either in the working component (motor or cylinder) or in the mechanical linkage beyond it. Flows from the motor or cylinder in the stalled or run-out position can then be measured to determine slippage or leakage. Difficulty can then be attributed to the working component or the mechanical linkage.

Thus, by reading volume pressure drops from unit to unit, percentage of total loss can be determined in each component, and it can be learned which components, if any, are the cause of the machine's sluggishness or failure.

• **Circuit efficiency testing** —Scheduled preventive maintenance testing will frequently show inefficiency before an operator complaint, thus allowing the mechanic to maintain machine efficiency at a constant high level. For such tests, a tee is inserted in the pump pressure line at any point between the pump and the valve block.

With the portable-tester pressure port connected to the tee, and the return port to tank, each valve is then operated in each direction until its cylinder is run-out, or its motor stalled at the test pressure. A reading of the tester then indicates the volume available to each component at test pressures.

One or more readings below proper volume indicate leakage or slippage, and the degree of such inefficiency. The particular component failure is then identified by the point-to-point general procedure, or many times, by interpretation of the general test results through experience and familiarity with the circuit. ▼▼▼

Volume-Pressure Relationship

Proper functioning of hydraulic equipment requires the correct fluid flows at the required pressures at the various points in the hydraulic circuits. Pressure readings alone are not sufficient evidence for trouble-shooting.

Slippage under pressure, present in most components, increases drastically with wear and heat, wasting flow until the available volume reaches zero. Only then does pressure fall off below load requirements, announcing complete failure. Therefore, measuring inefficiencies between new condition and failure requires pressure and volume measurements.

Trouble-shooting and preventive testing by volume-pressure relationship is not prevalent in spite of its importance. Common practice is to measure pressure only, possibly for lack of realization that pressure tells whether—but volume tells how fast—the system can accomplish the hydraulic job.

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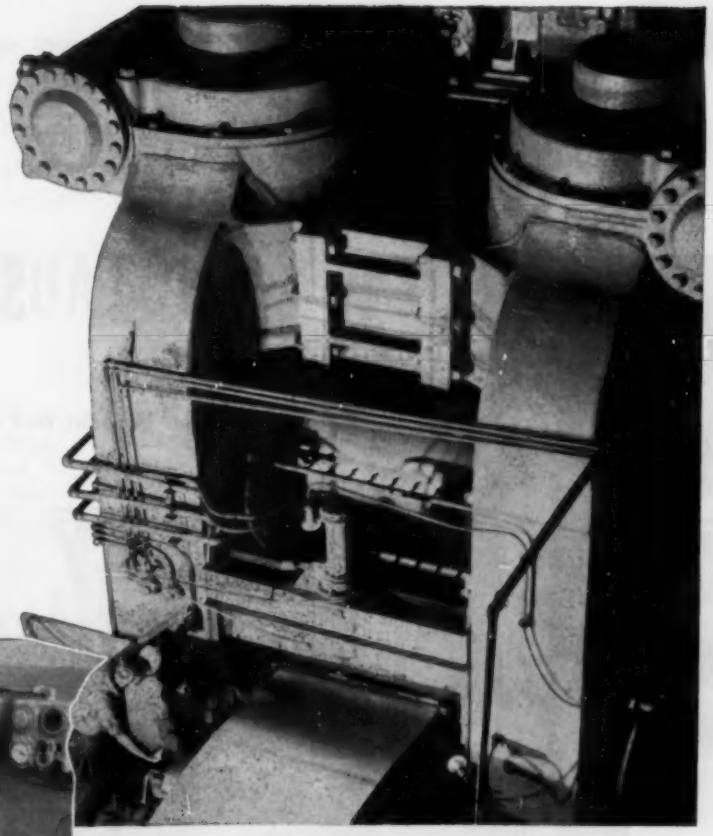

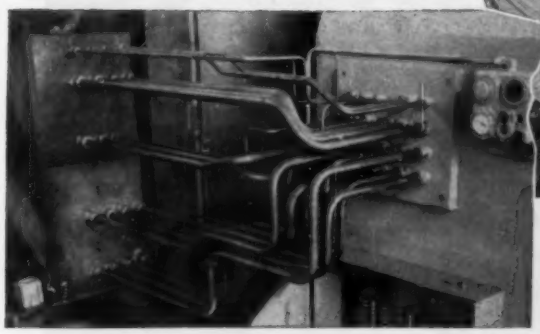

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⅜	X	X	X	X						
½		X	X	X	X					
⅝			X	X	X					
¾			X	X	X	X	X			
⅞				X	X	X	X			
1				X	X	X	X	X	X	X
1¼					X	X	X	X	X	X
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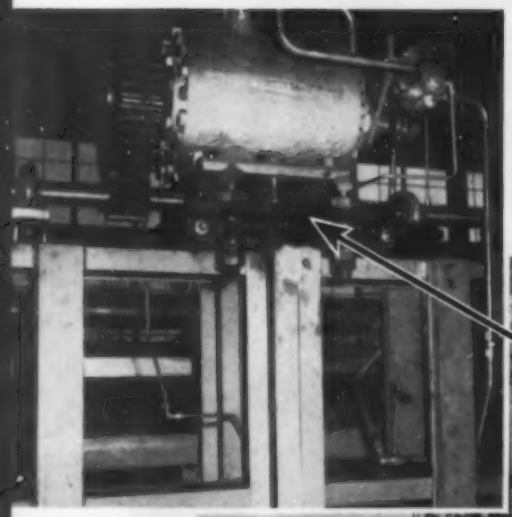
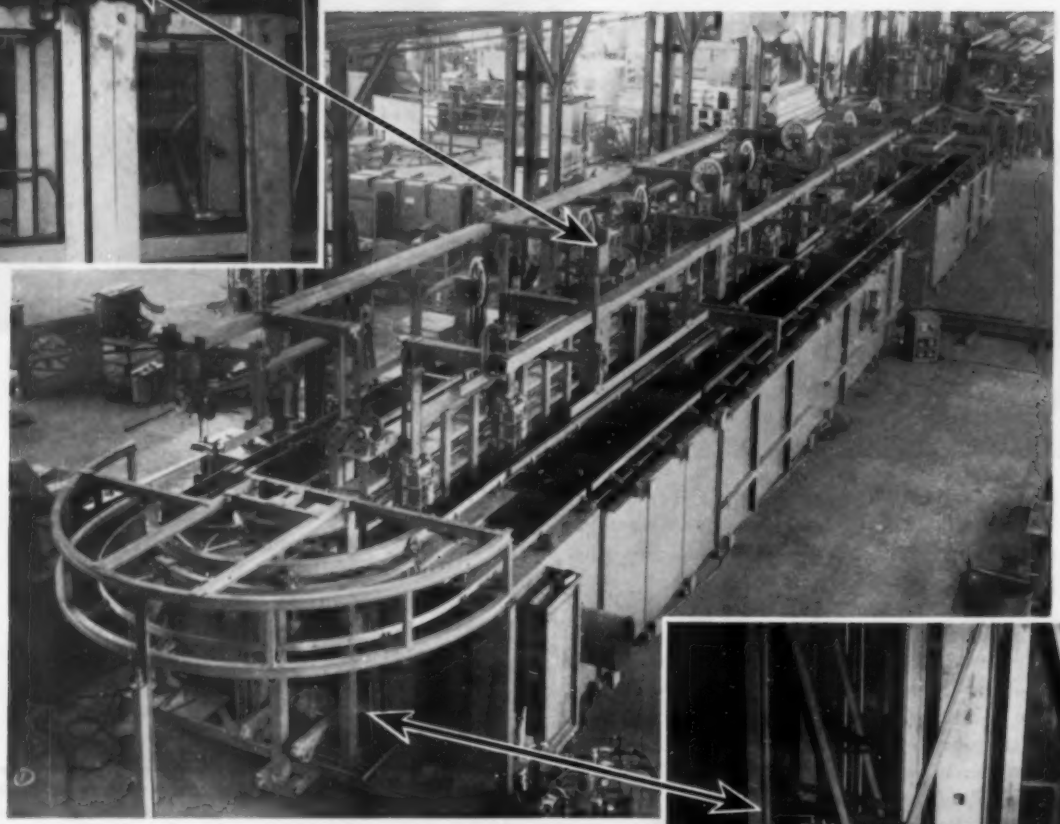
Here is a development story in applying deceleration valves to control starting and stopping of rotary actuators. Several designs were tried before arriving at the present arrangement which gives . .

SMOOTH MOTIONS

• By Dan Borodin and Rex C. Burnham





PLATING MACHINES such as this with a new conveying principle eliminating elevating superstructure result from the application of rotary actuators for vertical and horizontal motion.

VERTICAL MOTION is achieved by rotary actuator driving central shaft with pinion and rack arrangements. Counter-balancing loads on one side of the machine with loads on the other reduces required torque on the actuator. Deceleration has been accomplished by modification of a standard valve. *(top)*

HORIZONTAL MOTION is achieved by rotary actuator driving through a crank. This arrangement gives harmonic motion with inherent acceleration and deceleration. Space is conserved because of the elimination of overtravel. *(right)*

WITH ROTARY ACTUATORS

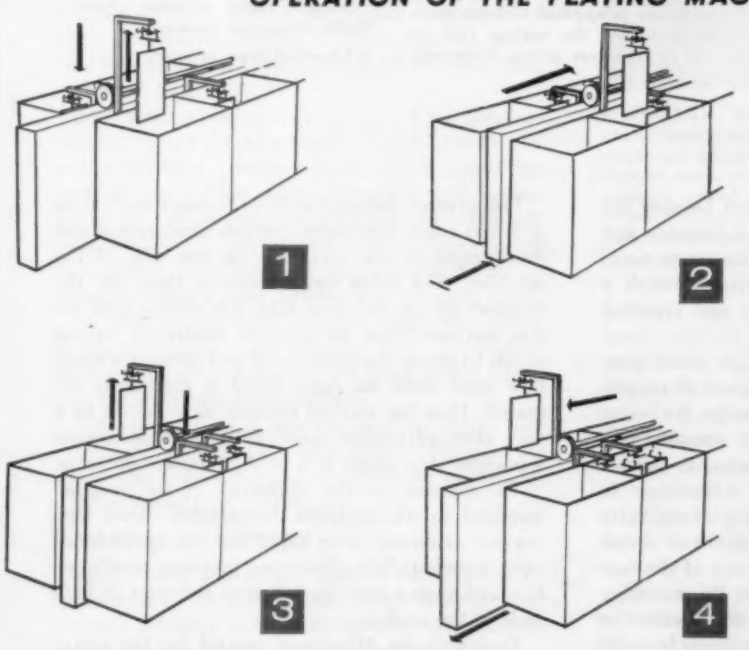
CONTROL of acceleration and deceleration on plating equipment is the result of several design changes in the deceleration valves and method of actuating them. Smooth action of the conveying and transfer mechanisms was a primary design objective for engineers at Wagner Bros., Inc., Detroit to eliminate the usual jolting movement which shakes parts loose from their racks during plating and requires shut-downs while these parts are fished from the tanks. The use of hydraulic rotary actuators to power machine motions has resulted in the elimination of elevating superstructure, transfer cams, chains and sprockets, and hydraulic cylinders above the tanks. Because of the balanced design of the rack-and-pinion action, the machine requires one-half the power of comparable units.

DAN BORODIN, *Chief Engineer, Wagner Bros., Inc.* REX C. BURNHAM, *Manager Hydraulic Div., J. N. Fauver Co., Inc. Detroit, Mich.*

VERTICAL MOTION

In the early stages of design, the rotary actuator which lifted and lowered the work was controlled by one deceleration valve metering input on one stroke and output on the reverse stroke. The main disadvantage of this system was that when the deceleration valve metered flow into the rotary actuator, negative loads acting in the direction of motion caused the vane of the hydraulic actuator to break away from the pressure oil. This resulted in cavitation and erratic motion of the elevating mechanism. The disadvantage of this system was the difference in acceleration and deceleration between lifting work on each side of the machine because

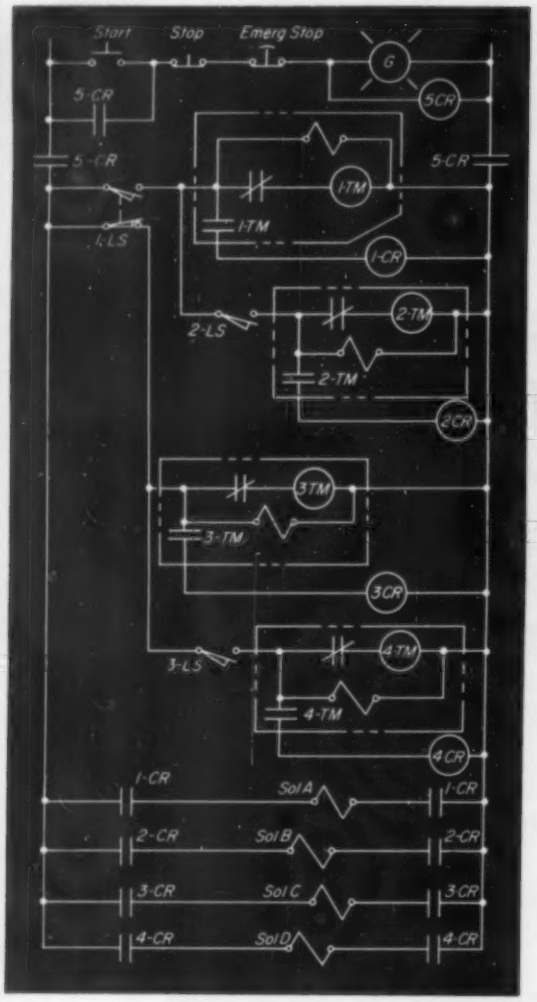
OPERATION OF THE PLATING MACHINE

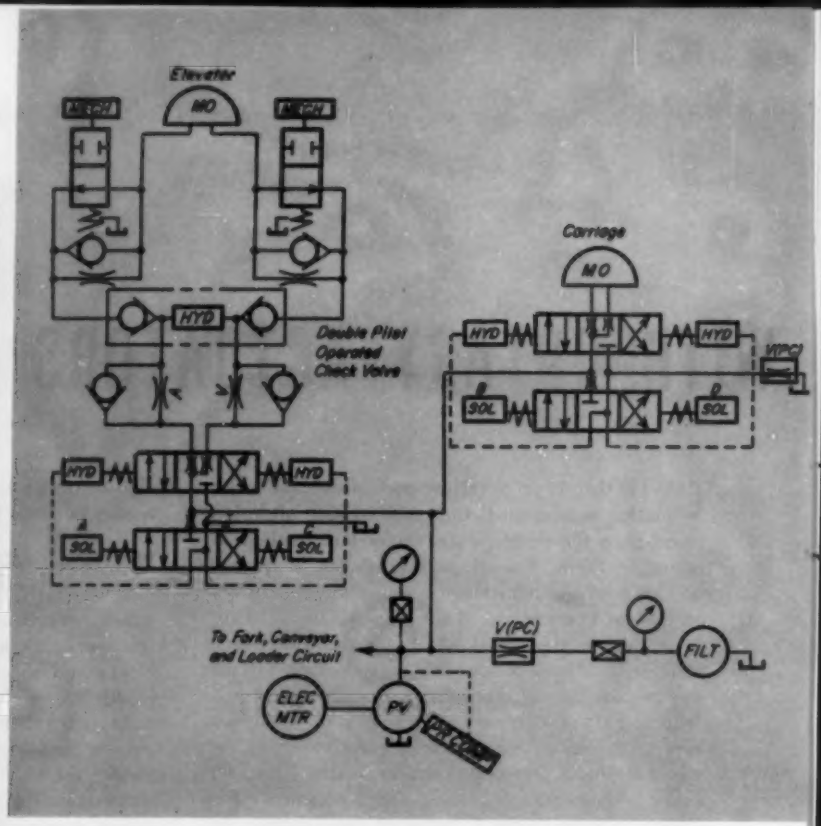


All transfer and conveying mechanism is mounted on a reciprocating carriage located between the two rows of tanks. The parts are brought through the full plating cycle by two basic movements: forward and reverse horizontal motion, and raising and lowering vertical movement.

Plating racks are attached to work carriers at the loading station. When the machine is started, lifting arms fixed to the carriage engage the work carriers and lift them at all transfer points on one side of the machine, carry them forward to the next station where they are lowered and disengaged from the lifting arm. At the same time, this sequence is produced in reverse by the carriage on the opposite side.

ROTARY ACTUATORS





HYDRAULIC CIRCUIT shows directional and speed control valving for elevator and carriage actuators. Elevator actuator is locked in position by applying pressure to both lines. Pilot-operated checks open slightly when pressure is applied to both lines to maintain the system full of oil at all times giving a smooth throttling action when the directional valve is shifted.

In the electrical diagram, the limit switches are actuated as follows:

1-LS—Right elevators up. Reversed right elevator down.
2-LS—Carriage forward.
3-LS—Carriage reverse.

of the difference in loads. This occurs because the machine is constructed to lift work on one side and lower work on the other side at the same time. When the rotary actuator which drives through a central shaft is reversed, the lifting and lowering is also reversed.

Another feature of the early design which gave way to improvements was in the method of mounting the deceleration valves. Originally the valve was mounted directly on the rotary actuator with no provision for adjustment in relation to the actuating cam. This meant that any adjustment in the initiation and pattern of actuating of the valve had to be done with the cam position and shape. To adjust either the mounting or shape of the cam was a time consuming, difficult job. By mounting the deceleration valve on a slide, the position at which the vertical slide starts to decelerate is easily controlled as shown graphically in the figure.

The present design has two deceleration valves and four cams. One valve controls acceleration and deceleration of the up-stroke on one side of the machine. The other valve controls these on the down-stroke on the same side. The valves used for this purpose have an integral controlled orifice which bypasses the main spool and permits a small flow even when the main spool is completely actuated. Thus the vertical elevator slows down to a very slow adjustable speed until it stops against a positive stop where it is held by system pressure.

To improve on the operation of the original standard valves, modified deceleration valves having an extremely long taper on the spool lands were installed. This eliminated previous erratic action and gave a very smooth stop and start at both ends of the stroke.

Designing the directional control for the rotary actuators required some means of locking the actu-

ators in any position in case of a power failure. In addition, flow control valves had to be incorporated to regulate speed of the actuators in both directions. The directional valves were to be solenoid controlled, but operation had to be smooth enough to eliminate jump when the solenoids were energized.

In one earlier design, a closed center, 4-way valve was selected with individual flow control valves in both lines to the rotary actuator. To insure a positive lock, pilot-operated check valves were installed in each line. A difficulty in this type of locking is that the only drain for oil from the pilot cylinders of the check valves is by leakage through the main directional valve spool. Since this trapped oil must be drained before the check valve can seat, the valve can remain open eliminating the locking feature.

An improved design makes use of a "stack" valve or directional control valve, pilot-operated check, and flow control manufactured so that they can be mounted together in a stack. This makes a very compact installation on a panel. A special spool was made for the ¾-inch directional valve, so that in the center, neutral position pressure is applied to both sides of the rotary actuator. In this position the valve outlet ports are slightly open to pressure over a gradual taper of the spool. By holding pressure on both lines, compressibility effects of the oil are reduced and any jump when the valve is shifted is eliminated. A difficulty of obtaining a positive lock is the larger leakage of rotary actuators compared to cylinders.

The double, pilot-operated check valve is constructed so that both balls permit a small flow when pressure is applied to both cylinder ports. This maintains the system full of oil at rated pressure at all times.

This arrangement points up one of the inherent advantages of a rotary actuator. Like the double rod end cylinder for linear motion, the actuator has equal pressure areas in both directions making this system of locking possible. This method would not work for a single-end cylinder, because there would be a differential circuit set up with a drift of the cylinder caused by the difference in pressure areas.

To slow the valve shifting, an orifice was added in the directional valve to meter fluid to the pilot section. This gives a smooth throttling action whenever the solenoids are energized.

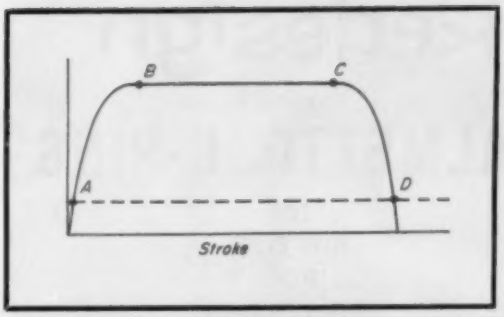
The redesign using two deceleration valves and other improvements has resulted in a 30% possible increase in production of the machine as well as a better quality of plating.

HORIZONTAL MOTION

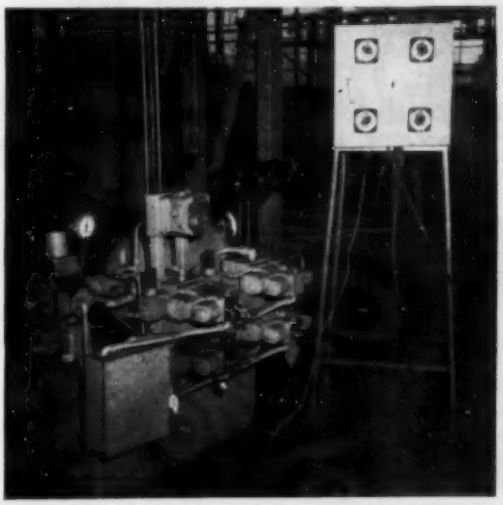
Acceleration and deceleration of the carriage in the horizontal direction is accomplished by linking a rotary actuator to the carriage through a crank mechanism. As the actuator swings through its arc, the resulting linear motion of the carriage is harmonic—that is it speeds up to a maximum velocity and then slows down to a stop in the relationship of a sinusoidal curve. Speed of the actuator is controlled by a presure compensated flow control valve. The pressure compensated flow control valve was selected because of the variation in load on the carriage rotary actuator during its stroke. This is caused by the variable mechanical advantage produced by the bell crank and connecting rods acting against the carriage.

This valve has a locking feature in which the adjusting knob is spring-loaded to a locked position. Fine adjustment is then possible with a vernier

Concluded on page 128



SLIDE MOUNTING OF DECELERATION VALVES permits easy adjustment of points where acceleration ends (B) and deceleration begins (C). (A) and (D) represent points where valves are completely closed. Small adjustable bypass orifice produces a slow creep againt a positive stop.



HYDRAULIC POWER UNIT and electrical control panel incorporate a 20-gpm pressure-compensated vane-type pump driven by a 7½-hp motor, Flow control valve shown mounted over directional valves controls speed of actuator for horizontal motion. "Stack" directional valves in the present design mount directional control, flow control, and pilot-operated checks as one unit.

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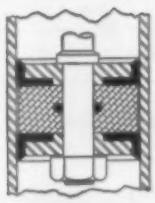

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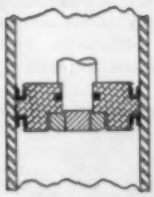

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SMOOTH MOTIONS WITH ROTARY ACTUATORS

Concluded from page 128

which has a 50:1 ratio in respect to the main adjusting knob. This gear ratio is sufficient to prevent vibration from changing the valve setting. To make a rapid adjustment of the valve, the main knob can be depressed, disengaging the vernier mechanism.

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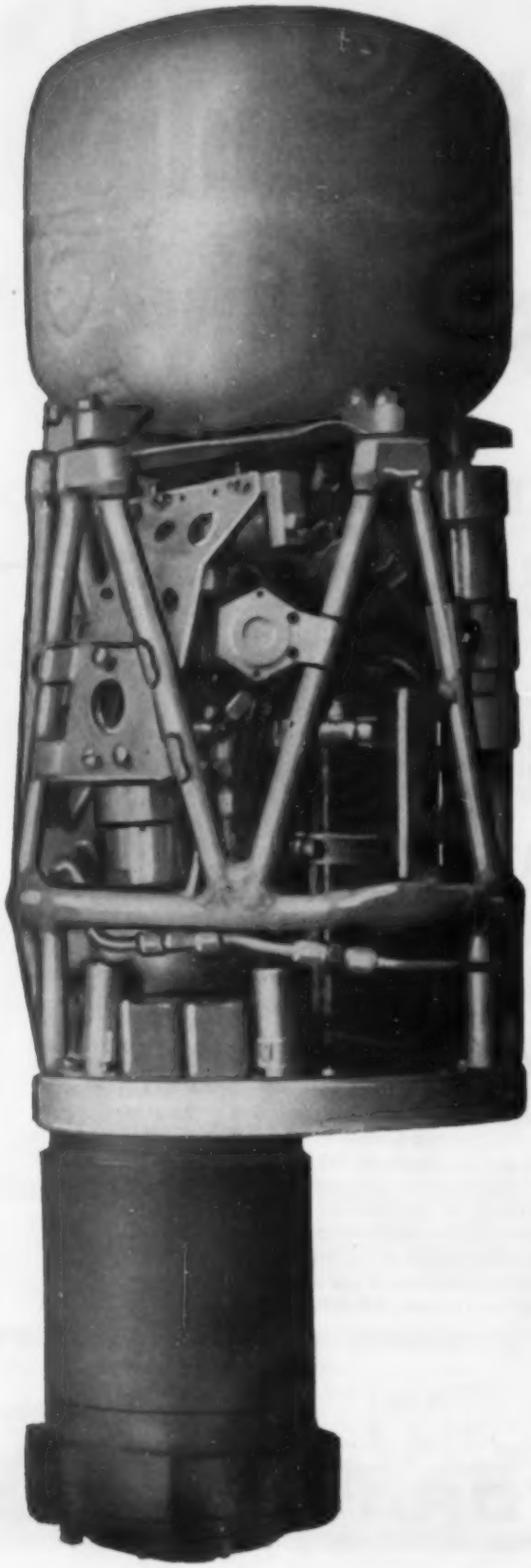

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AVIATION SECTION

Applied Hydraulics

OCTOBER 1957

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By Scholer Bangs

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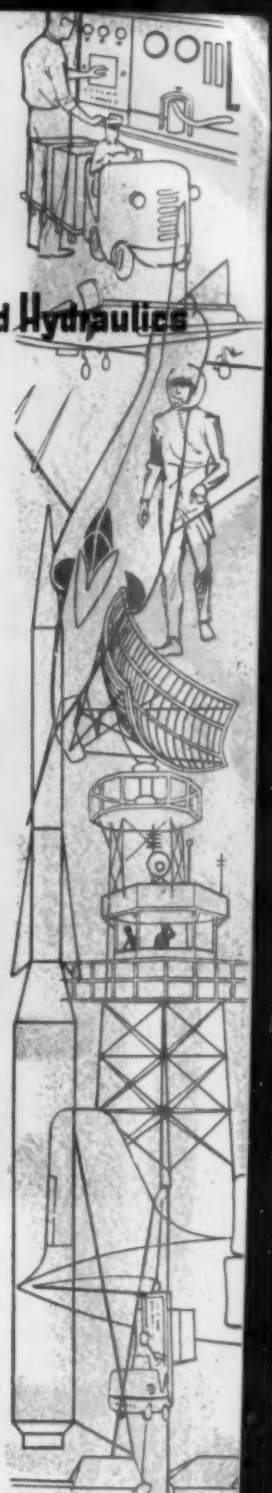

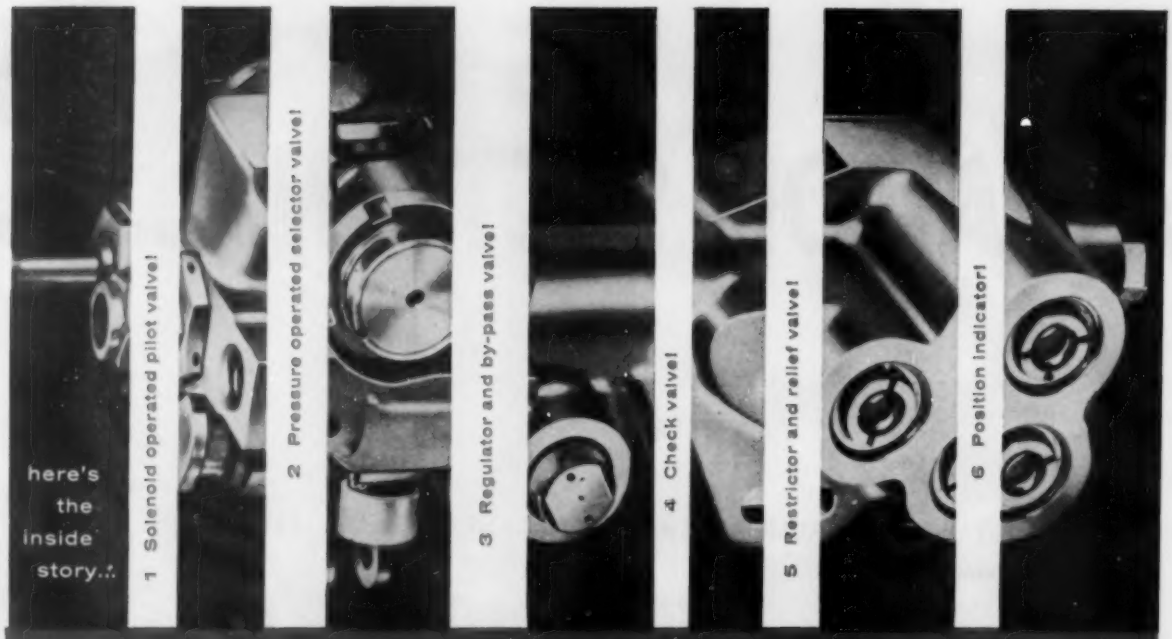
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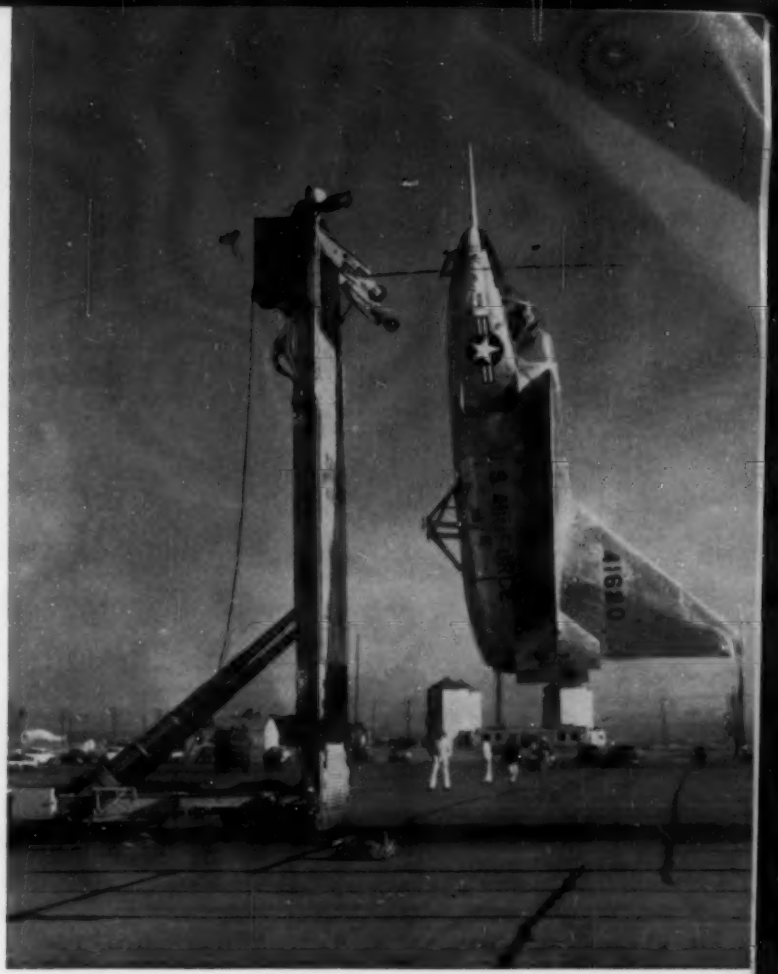
Midwest Representative: Mr. E. A. Polowniak 11767 Fawnridge Drive, Kirkwood, Missouri Telephone: YOrktown 6-4861

First vertical takeoff and landing of the Ryan X-13 Vertijet on April 13 of this year were an unqualified success due in part to the performance of some hydraulic equipment which never got off the ground. Task performed by this equipment was to see that the airplane never got on the ground.



VERTIJET USES HYDRAULICALLY ACTUATED LANDING FIELD

• By Scholer Bangs,
Western Editor

LANDING field of the Ryan X-13 Vertijet is actually a large flatbed trailer. Takeoffs and landings are performed by either hooking or unhooking a large hook at the nose of the aircraft from a 1-in. steel cable which is held away from the trailer bed during initial stages of landing and final stages of launching by two hydraulic cylinders. Hydraulics are also used to raise the trailer bed from the horizontal travelling position to the vertical launching position and return it. The system was developed by Fruehauf Trailer Co. in conjunction with Ryan Aeronautical Co. designers.

• **Operating Sequence**—Initial step in launching the Vertijet is to raise the launching platform, or trailer bed from the horizontal to a vertical position. This is done by two large hydraulic cylinders which quickly and easily raise the 9000 lb bed plus the undisclosed weight of the aircraft. With plane and platform in vertical position, the turbojet engine is started. Entire weight of the plane is supported by a cable strung across the platform which engages the nose hook of the plane.

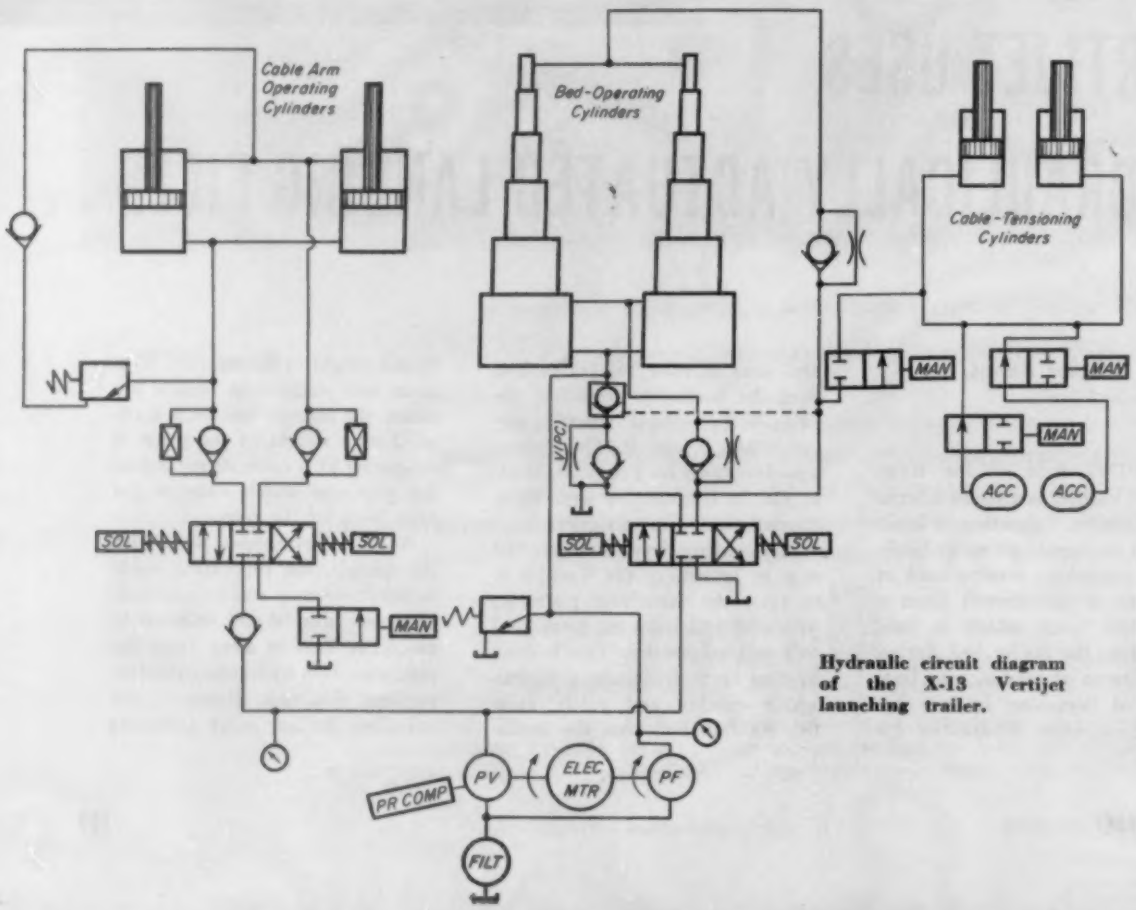
As the pilot applies power for the takeoff, the supporting cable is simultaneously and automatically moved upward and outward to move the Vertijet away from the platform. Two hydraulic cylinders perform this task. However, the cylinders do not exert sufficient

HYDRAULICALLY ACTUATED LANDING FIELD

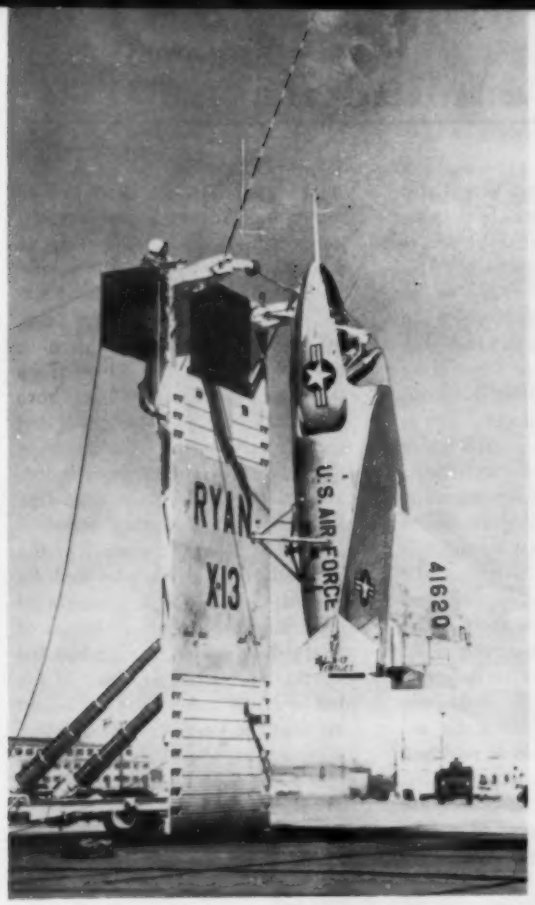
AVIATION

Initial step in vertical launching is raising trailer bed and plane from horizontal to vertical position. Two large six-stage cylinders perform this job. Largest stage is 27-in. diameter; smallest is 6-in. Time from horizontal to vertical position is 3-½ minutes.

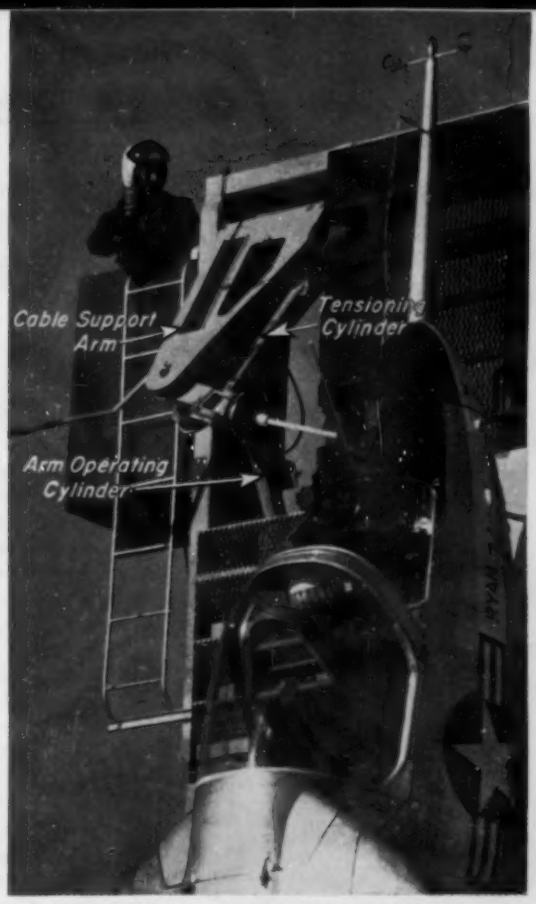
Fully extended bed-raising cylinders are 173 in. long. Retracted length is 47 in.



Hydraulic circuit diagram of the X-13 Vertijet launching trailer.



With cable arms fully extended, the Vertijet is ready to lift off the cable.



Closeup of the X-13 hanging from the cable on its launching trailer.

force to actually lift the plane, a certain amount of plane weight must be cancelled by jet thrust of the engine before this operation can be performed. Then, when sufficient thrust is exerted the craft lifts upward, the nose hook disengages and the X-13 is airborne.

When airborne, the transition from vertical to horizontal flight attitude is made and flight in a conventional manner takes place. At the conclusion of the flight, transition to vertical attitude takes place. The pilot then maneuvers toward the trailer bed to re-engage cable and nose hook for landing.

Contact with the cable actuates a sensitive switch which energizes a solenoid valve. This in turn causes the cable to be swung upward and outward, in a manner similar to that of takeoff, and firmly engage the nose hook. As thrust is decreased and the aircraft weight placed upon the cable, the cable tensioning system permits the cable to sag about 6 in. This permits the entire aircraft to slide along the cable and automatically center on the trailer.

As jet thrust is further decreased, the cable supporting arms swing inward until the nose hook and tubular support frame contact the trailer bed. Bed and aircraft are then lowered from vertical to horizontal to complete the sequence of events.

• **Hydraulic System**—Circuit diagram shows the various components of the hydraulic system. A 220-v, 20-hp electric motor operating at 1200 rpm drives a 32-gpm pump operating at relief pressure of 750 psi and a 0.5-gpm pump limited to 1250 psi by a relief valve. Output of the large pump is used for raising and lowering the bed as well as operation of the cable arm cylinders. Output of the small pump serves to hold the bed cylinders in the extended position with much less power loss than would be involved if output of the large pump were used for holding.

Bed cylinders are 6-stage with nested length of 47 in. and extended length of 173 in. for a total stroke of 126 in. or 10.5 ft. First and sixth stages of these cylinders are double-acting to draw the raised bed back over the center of gravity. Cylinders are then collapsed by the weight of the bed and airplane. Flow control valves limit rates of extension and retraction of these cylinders to provide smooth operation.

Cable tensioning cylinders are single-acting with 1½-in. bore and 8-in. stroke. Ordinarily, this circuit is simply filled with oil at 750 psi and then disconnected from the remainder of the circuit by a globe valve. Two 1-pint accumulators in the tensioning circuit cause it to function as though the cable were spring loaded and allow the cylinders to retract when airplane weight is on the cable.

Cable arm cylinders are powered by the large pump. Pressure is always applied in a direction to extend these cylinders except when positioning the arms after takeoff

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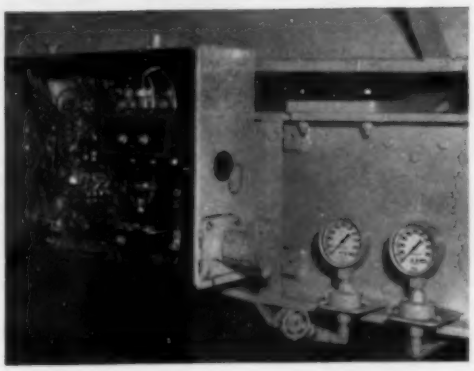
and prior to landing. Arms are positioned a bit below horizontal for landing. This position does not correspond to full extension or retraction of the cylinders. When the nose hook contacts the cable, the left-hand solenoid on the four-way control valve in the arm-operating circuit is energized to fully extend the cylinders. Rate of extension is controlled by a flow control valve metering oil out of the cylinders. With the cylinders fully extended and the airplane's weight applied to the cable, net force on the cylinders is sufficient to retract the cylinders. Relief valve connected to the head-end line then opens and oil passes through the relief valve and a check valve in series to the rod end of the cylinders. Excess oil which cannot be accepted at the rod ends is returned to tank via the flow-control valve.

With this circuit, any decrease in airplane weight applied to the cable will immediately result in a tendency for the cylinders to extend since pump pressure is always applied to the head end of the cylinders. Any actual upward movement of the aircraft will, of course, be followed up immediately. The system functions in exactly the same fashion during takeoff, staying right with the nose hook throughout the limits of its travel. Cylinders are 3-in. bore x 32-in. stroke. Manually-operated shutoff valve in the tank line from the cable arm operating cylinders and check valve in the inlet line lock the system during travel.

Electrical remote control of the hydraulic system is provided by a control box which connects to the trailer with a 100-ft length of heavy-duty cable. This enables the operator to be safely clear of the hot exhaust gases and turbulent air near the Vertijet. Although this system was intended for use on the ground at a distance of approximately 100 ft from the trailer, it was used from a crow's nest at the top of the raised trailer bed during the experiments to allow a better view of the operations. ▼▼▼

Hydraulic pumps and drive motor are mounted between main chassis rails, near lower ends of bed-raising cylinders.



Connector at right end of trailer control box is for 100 ft. length of heavy-duty electrical cable to permit remote operation of all trailer hydraulics. Pressure gages show high and low system pressures.

NEW TITEFLEX

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TEFLON* HOSE ASSEMBLIES

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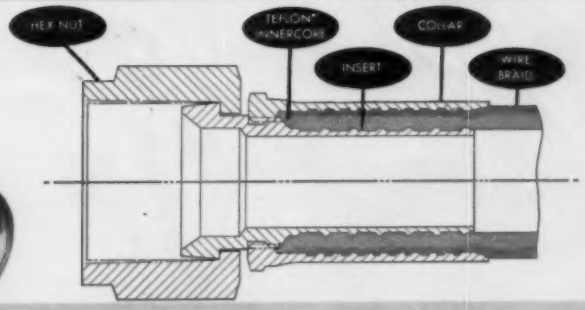

Here—from Titeflex—are the hose assemblies you have long wanted for critical aircraft and industrial hydraulic applications. Not only do these new Titeflex Springfield "110" Teflon* Hose Assemblies exceed the latest military specification burst requirements by as much as 30%, but they are also leakproof, even when tested at rated operating pressure after temperature cycling between −100°F and +500°F.

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RANGE OF SIZES AVAILABLE—Nominal hose diameters from ⅜" to 1¼" are already available. Fitting configurations may be ordered to meet individual requirements. For detailed information, write Titeflex, Inc., Hendee Street, Springfield 4, Mass.

*Teflon is a DuPont trademark for its tetrafluoroethylene resin
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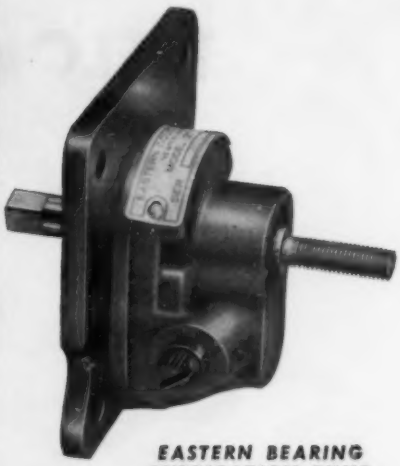

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Extensive testing and experimentation is being conducted by aircraft and material manufacturers to find the solution to the high temperature problem. Recently a Government contract for the development of a 1000 F hydraulic system went to Republic Aviation Corp. They've done considerable development work in the area beyond today's practical top temperatures. Here's their report on a new . . .

CERAMIC FIBRE REINFORCED MATERIAL

. . . for 500 F backup rings

HIGH temperature and extrusion are two of the biggest problems confronting designers of high-temperature packings for developmental aircraft. While standard combinations of elastomeric O-rings and leather backup rings perform quite satisfactorily on present aircraft, new materials with superior properties are a necessity if designs now in development are to meet specifications.

Search for a material to prevent extrusion of O-ring packings in the 500 F range was narrowed down to the fluorocarbons because they showed the most promise. Tests of all available materials of this group have been going on for several years now.

• **Materials Tested**—Virgin Teflon was the first material tested in the program to develop a 500 F antiextrusion ring. Results were satisfactory at temperatures to 350 F, but any further increase in temperature resulted in premature failure. A glass fiber-graphite loaded Teflon proved to be an improvement. However, at 500 F, performance was marginal to the extent that this material could not be considered an unqualified success.

A more recent development, a ceramic fiber reinforced sheet material* was then tried. Manufacturer's tests of this material indicated that it possessed to a greater extent than any other available material, the ability to withstand high temperatures and pressures without distortion or cold flow. Table 1 illustrates this point by comparing deformation of this material with virgin Teflon and a typical filled Teflon compound.

The ceramic fiber reinforced sheet material tested quite satisfactorily at 500 F. Several tests were run to more than 50,000 operating cycles at this temperature with no deterioration of the material. Silicate Ester hydraulic fluid

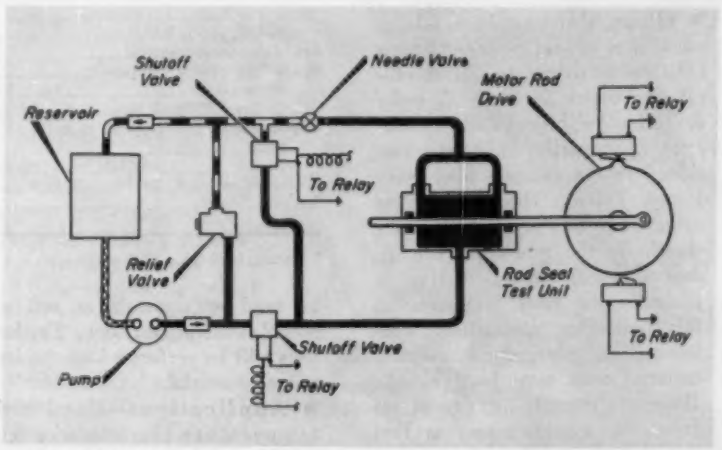

FIG 1. DIAGRAM of the rod seal test apparatus shows its simplicity. Instrumentation for accurately measuring temperatures and pressures in the system is a portion of the setup not shown here. Pressures and temperatures are, however, accurately measured and controlled during tests.

* *Duroid 5600. Produced by Rogers Corp., Rogers, Conn.*

was used. Until quite recently it was impossible to test this material at temperatures higher than 500 F because suitable O-ring materials for these temperatures were not available. However, an O-ring compound for these temperatures has become available and presently incomplete tests indicate that the material will be satisfactory for service at temperatures to 600 F.

• **Test Method**—Method used for evaluating the performance of these materials is a relatively simple test. It simulates actual service in a component. Reliability of the method is considered to be quite high. Known as the *rod seal* test, the method consists of fitting the test unit with the packings to be tested and then reciprocating a rod back and forth through the seals, Figure 1. The rod is driven by a crank driven by an electric motor. A needle valve in the circuit is used to adjust the amount of restriction in the outlet line from the test unit and thus vary the pressure applied to the packings under test. Shutoff valves in the circuit are controlled by limit switches and a cam driven by the rod drive motor. Alternate closing of these valves produces pressure fluctuations in the system to approximate actual operating conditions.

• **Other Properties**—As in most cases certain desirable things must be sacrificed to obtain others. As shown in Table 2, some of Teflon's electrical and dry lubricating properties have been sacrificed in the ceramic fiber reinforced Teflon. There are other differences in the characteristics shown by the table, but the increased coefficient of friction is probably the most important in this particular application. This has made it necessary to use this material with very hard metals. However, recently information from the manufacturers is that they have succeeded in restoring most of the pure fluorocarbon's lubricating properties and it may be used with metals as soft as Monel without abrasion. Further tests will be performed on the improved material.

• **Applications**—Good high temperature characteristics and machinability have made the ceramic fiber reinforced Teflon semi-standard for backup rings, with this company. Present development plans call for its use in all hydraulic systems of an aircraft now being developed. These applications include speed brakes, landing gear and wing flaps. No trouble is anticipated in operation of these systems at 500 F because of backup ring failure. ▼▼▼

TABLE 1—COMPARISON OF DEFORMATION UNDER LOAD OF TEFLON AND TEFLON COMPOUNDS BY ASTM METHOD D621-51

Material	Deformation at 122 F @ 1200 psi (%)	Deformation at 122 F @ 3000 psi (%)	Deformation at 300 F @ 1200 psi (%)	Deformation at 300 F @ 3000 psi (%)
Teflon	4 - 8	25.0	4.3	25.0
Typical Filled Compound	0.8	5.2	1.0	13.0
Reinforced Compound *	0.6	0.8	0.8	0.8

* Duroid 5600

TABLE 2—PROPERTIES OF VIRGIN TEFLON AND CERAMIC FIBER REINFORCED TEFLON*

PROPERTY	ASTM METHOD	TEFLON	REINFORCED TEFLON *
Tensile Strength MD, psi	D1170-54T	2800	2500
Tensile Strength, CMD, psi	D1170-54T	2800	1500
Compressibility, 5000 psi, %	D1170-54T	—	8
Tensile Strength, MD, psi	D638-52T	1500-3000	
Tensile Strength, CMD, psi	D638-52T	1500-3000	
Stiffness, MD, lb./sq. in.	D747-50	50, -90,000	140,000
Stiffness, CMD, lb./sq. in.	D747-50	50, -90,000	115,000
Impact Strength, Izod.	D256-47T		
edge, ft.—lb./in.		3	1.10
face, ft.—lb./in.		3	1.50
Specific Heat, BTU/lb.—°F.		.25	.25
Thermal Expansion Coefficient per °F., 73-140°F.	D696-44	5.5×10^{-5}	2.7×10^{-5}
Heat Distortion Temperature, °F.	D648B-45T		
66 psi		250	500+
264 psi			500+
Dielectric Strength, short time, volts/mil	D149-44	400-500	150
Dielectric Constant, 60 cycles	D150-54T	2.00	2.7
10^6 cycles	D150-54T	2.00	2.5
Power Factor, 60 cycles	D150-54T	0.0003	.03
10^6 cycles	D150-54T	0.0003	.003
Surface Resistivity, ohms	D257-52T		
as received		3.6×10^{12}	1.4×10^{13}
96 hrs., 100% R.H.		3.6×10^{12}	4.2×10^{5}
Arc Resistance, seconds	D495-48	no track	195
Volume Resistivity, ohm-cm	D257-52T		
as received		$>10^{15}$	4.6×10^{11}
96 hrs., 100% R.H.		$>10^{15}$	1.6×10^{7}
Coefficient of friction against polished steel,			
static		.04	.21
kinetic		.04	.14
Water Absorption, 24 hrs., 70°F.		0.005	3.0
Specific Gravity	D792-50	2.1-2.2	1.90

* Duroid 5600

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AVIATION NEWS

from the fluid power field

DETROIT—Seventh Aircraft Hydraulics Conference has been announced by Vickers Inc. Meetings will be held November 12 and 13 at the Park Shelton Hotel in Detroit. Integration of hydraulic components and subsystems into overall aircraft systems will be stressed. Strong emphasis will be placed on means of optimizing hydraulic system design. An open forum discussion of maintenance and service ideas, problems and solutions will also be included. Attendance will be by invitation only.

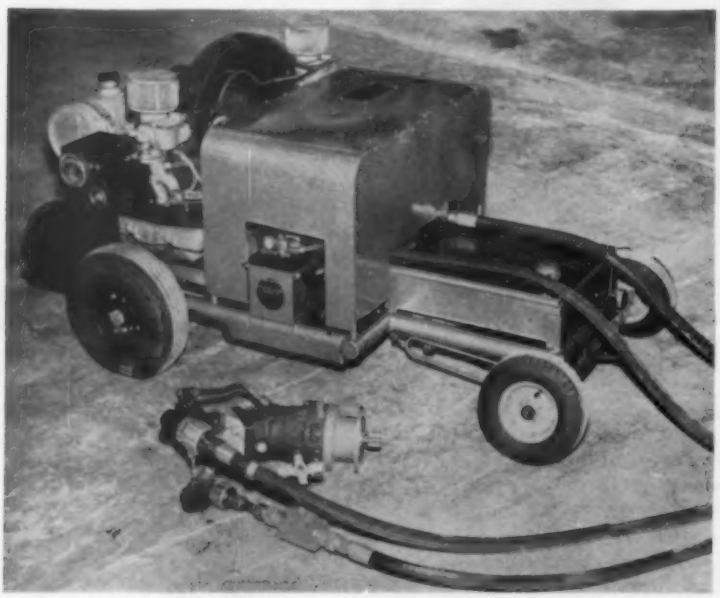
Albert J. Seifert has been appointed to the newly-created post of Manager of Manufacturing Engineering at **Dalmo-Victor Co.**, Belmont, Calif. Mr. Seifert will be responsible for coordinating the activities of methods, application, and tool design and control sections. Prior to joining Dalmo-Victor, Mr. Seifert was manager of industrial engineering at Talon Mfg. Co. Inc., Meadville, Pa. He was also chief engineer for J. Sklara Mfg. Co., Long Island City, N. Y. for three years.

Appointment of **Carl K. Wolff** to the post of Western Regional Sales Manager, **W. S. Shamban & Co.** has been announced. Formerly Senior Sales Engineer and

Carl K. Wolff
W. S. Shamban Co.

Div. Product Coordinator of National Seal Div., Federal-Mogul-Bower Bearings Inc., Mr. Wolff will be at the Shamban plant in Culver City, Calif.

Appointment of **William H. Rowley** as manager, military requirements has been announced by **Aeroquip Corp.**, Jackson, Mich. The newly created post will involve technical liason work with regulatory departments of military aeronautical services, the CAA and SAE standards committees. Mr. Rowley's offices will be at field sales headquarters at Dayton, O. Formerly, he was manager of the Dayton office.



DETROIT—A new hydraulic ground-mobile jet engine starter has been announced by Vickers Inc. The prime mover drives a variable-delivery, pressure-compensated pump with an over-all efficiency of 92%. Servo controls on the prime mover and pump assure optimum speed to a hydraulic starting motor which is mounted on a pad on the jet engine during starting. A substantial reduction in prime mover horsepower is claimed for the unit as well as system simplicity and reduced weight.

Successful demonstrations have been made on the Allison 501-D4 turboprop engine and the J-57 tubojet. Average time to idle speed was 40 sec for the 501-D4 and time to cutout for the J-57 was 31 sec. Prime mover horsepower requirement was about 33% of that of other systems for equivalent starting times. Unit pictured uses a 70-hp lightweight, air-cooled engine. To suit other requirements the unit may be fitted with 50 to 250-hp engines.

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Factory-assembled and individually tested under close supervision, BRAID-LOK fittings are designed to grip the wire braid between metal surfaces. Teflon inner liner is trapped separately, forming a perfect seal . . . the higher the pressure, the tighter the seal. Meets the latest military standards.

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"super gem*" FITTINGS
DETACHABLE – RE-USABLE

Can be attached or removed in the field, using standard bench tools. Design assures three functions: (1) grips and holds the external wire braid firmly; (2) seats the inner tube without compression thus forming a lip seal; (3) positive metal-to-metal line seal.

by WEATHERHEAD

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- Freedom from line contamination.
- Tested to conditions in excess of MIL H-25579 requirements and those of airframe, engine and missile manufacturers.

*"super-gem" is an Aeroquip trademark.

*"Teflon" is a Dupont trademark.

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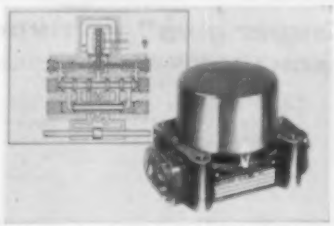

completely balanced push-pull construction. No springs are used in the valve which has a minimum of moving parts. A large capacity filter element protects the control stage.

As illustrated, the valves consist of an electro-mechanical transducer and a hydraulic control circuit. Motion of the transducer is induced by a direct current which deflects the armature to restrict one or the other of two orifices and thus vary pressure at the ends of the main spool causing it to shift. Three models make up the series of valves, the FC200, FC210 and FC220.—*Cadillac Gage Co., Detroit, Mich.*

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. . . available are described in 12-page brochure containing a complete illustrated description of the company's plant and equipment facilities, along with details of services offered to manufacturers of military and commercial equipment, including environmental and qualification test, design evaluation, research and development, production sampling, test equipment design, inspection methods and procedures, and quality control analysis. *Facilities Brochure, Aerotest Laboratories, Inc., College Point, N. Y.*

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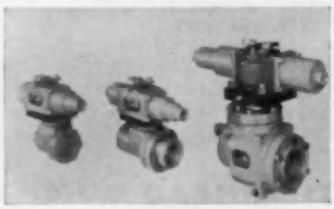
Pressure-Operated Valves

. . . for —320 to 200 F

New light-weight series of pressure-operated shutoff valves are designed for bubble-tight operation to 3000 psi. Available in line sizes from ¼ to 3 in., the valves have exclusive floating ball-seat arrangement with self-wiping, self-lapping action. Hole-in-a-ball design results in straight-through flow with minimum pressure drop.



Typical media handled are: oxygen, liquid oxygen, nitrogen, liquid nitrogen, air, liquid air, helium and other liquids and gases. Actuating times are as low as 25 millisec. Actuators may be single or double-acting, gas or liquid operated at pressures from 200 to 750 psi. Actuators are thermally isolated from valve bodies. Ports are available per AND 10050, AND 10056 or ME 33514. Other configurations may also be specified. Enviromental requirements of MIL-E-5272 A are met or exceeded. Typical weight is 2.13 lb for the 1-in. model.—*Hydromatics Inc., Cedar Grove, N. J.*

Circle 302 on Reader Service Card

U. S. Air Force Reports

. . . on research in hydraulic fluids and lubricants, have been released to industry. There are two reports. One is an evaluation of a new silicate-base, high-temperature hydraulic fluid; the other covers development of a sonic test for determining shear breakdown in hydraulic fluids and lubricants. *Office of Technical Services, U. S. Department of Commerce.*

Circle 303 on Reader Service Card

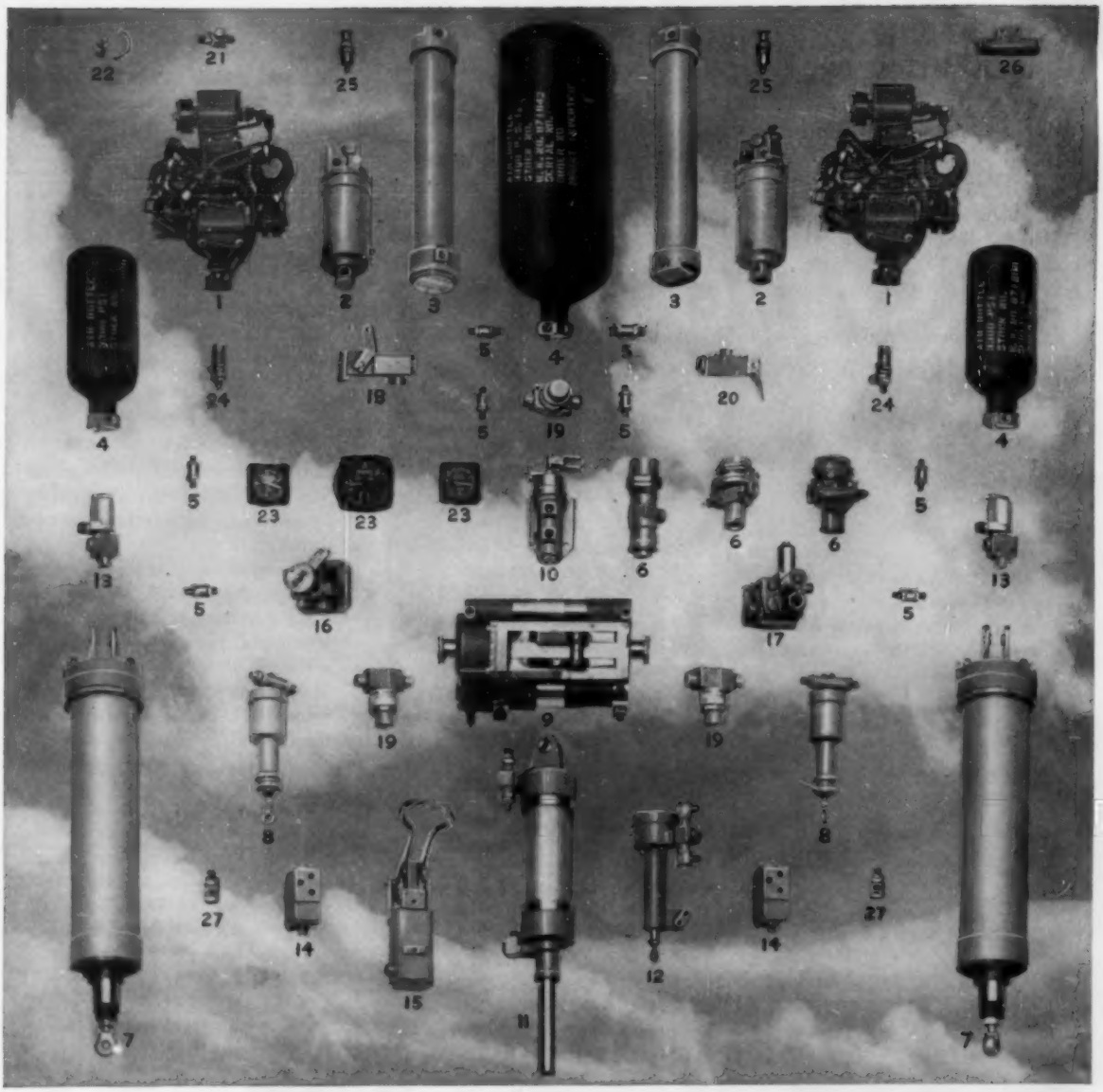
Oil-Cooled Motorpump

. . . saves space, weight

Designed for continuous-duty applications, a new oil-cooled motorpump is now in quantity production for turbine-powered transports. High efficiency of the variable-displacement, piston-type pump combined with liquid cooling result in a 25% saving in size and weight over conventional types.

Liquid cooling also eliminates the need for ductwork for electric motor cooling. This produces additional savings in airframe space and weight.

Continued on page 146



Here it is — all the hardware needed for an all-pneumatic aircraft. All the items shown are pneumatic system components on the new Fairchild F-27, and open the door to an exciting new era of aviation. Similar pneumatic equipment is now available from Kidde on an off-the-shelf basis, and modifications to your own specifications or design requirements are available through Kidde's vast creative engineering department. Let Kidde engineers show you how faster-operating, lighter-weight pneumatic systems can better solve your power problems!

1. Compressor
2. Moisture separator
3. Chemical dryer
4. Air bottle
5. Check valve
6. Pressure reducer
*7. Actuator, main gear
*8. Actuator, up lock main gear
9. Actuator, nose wheel steering
10. Valve, servo, nose steering
11. Actuator, nose gear
12. Actuator, up lock nose gear
13. Valve, propeller brake
14. Valve, wheel brake
15. Valve, emergency brake
16. Valve, emergency landing gear
17. Valve, solenoid, landing gear
18. Valve, manual, isolation
19. Filter
20. Valve isolation
21. Pressure relief
22. Valve, ground charging
23. Pressure gauges
24. Valve, relief
25. Valve, back pressure
26. Shuttle valve
27. Valve, rapid exhaust

Items 7 & 8 designed in cooperation with and furnished by Stratos Division of Fairchild.

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AVIATION COMPONENT DATA

Only 20 in. long and with motor diameter less than 4 in., the 31¼-in. long, 12-hp package is rated for 2000-hr service. The 400-cycle, 200-v motor drives a centrifugal pump for supercharging and coolant circulation as well

as the main pump. Delivery is 8 gpm at 2250 psi and reduces to 6 gpm at 2950 psi. At 3000 psi, flow is zero. These flow and pressure conditions provide constant horsepower over a wide range of operating conditions. Overall efficiency of the pump-motor combination is 75%.—*Vickers Inc., Detroit, Mich.*

Circle 304 on Reader Service Card

Test Equipment

. . . for aircraft equipment and accessories, and guided missiles, is described in a folder. Items listed include solenoid valve tester, sealed cavity leakage detector, mobile high-pressure air stand, and hydraulic test stand. *Folder, Accessory Controls & Equipment Corp., Newington, Conn.*

Circle 305 on Reader Service Card

Multiple Input Valve

. . . for flight controls

Designed for controlling a tandem hydraulic cylinder, the Hydomat flight control servo valve will accept mechanical input from the pilot as well as electrical inputs from electronic amplifiers. Means are provided to remotely select signal sources to provide one of three modes of operation. These are: 1. Manual, where mechanical signals operate the valve in the conventional manner; 2. Autopilot, where electrical signals operate the valve as a conventional electrohydraulic servo valve, and 3. Damper, where mechanical signals operate the valve as in the manual mode and superimposed electrical signals provide damping for improved airframe stability. In the auto-pilot mode, the pilot

can, in an emergency, mechanically override the electrical signal by overcoming a predetermined threshold force.

Normal flow rates are from 0.5 to 10 gpm. Typical electrical input for maximum flow is ±6 ma. Maximum hysteresis is 0.25 ma with 0.05 ma maximum threshold. Maximum operating breakout force is 1 lb.—*Hydraulic Research & Mfg. Co., Burbank Calif.*

Circle 306 on Reader Service Card

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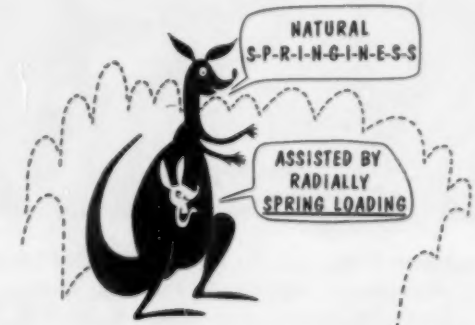

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Circle 48 on Reader Service Card

Data on Skydrol 500

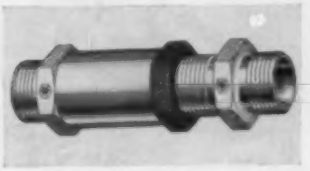
. . . is contained in two bulletins describing the fluid and its use in aircraft, and giving helpful technical information, and general properties of the fluid. *General Bulletin, and Technical Bulletin No. 0-135, Monsanto Chemical Co. St. Louis, Mo.*

Circle 307 on Reader Service Card

Flareless Union Assembly

. . . has adjustable feature

Unit is an assembly aid in hydraulic systems requiring a high degree of space utilization. It is used in many areas of aircraft and missile application where



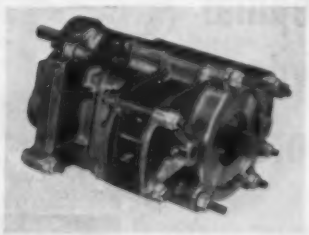
space does not allow the tubing to be sprung to accommodate the portion of tubing which must be positioned within the connector. Union is adjustable, and available in the -4, -6, -8, -10, -12, -16, and -20 sizes. It is suitable for hydraulic service at 3000 psi. *The Weatherhead Co., Aviation Div., Cleveland, Ohio.*

Circle 308 on Reader Service Card

Air Motor

. . . for 1000 F

Available in ratings from 0.66 to 30 hp, for operation at air pressures of 10 to 300 psig, these air motors are made from high-temperature magnesium alloys, stainless steels and stellites



matched to eliminate differential expansion problems. It is suggested as a reliable, fast-response power source for such applications as accessory drives, thrust reversers and actuation of air in-

Continued on next page

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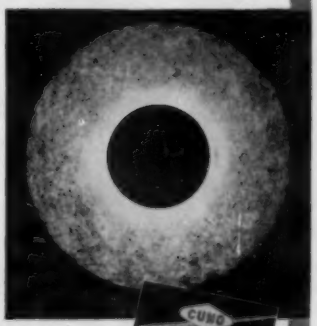

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AVIATION COMPONENT DATA

let and nozzle positioning systems. An exceptionally-high torque to inertia ratio allows the units to follow electronic modulation and deliver practically instantaneous starts and stops. One model will accelerate from zero to 100 rpm in 0.00004 sec with 30 psig air pressure against a load of 20 lb-in. Units are reversible and are equally efficient in both directions. Torque is proportional to gage pressure of the air and is virtually unaffected by temperature changes. A four-way control valve is an integral part of the unit.—*Lear Inc., Grand Rapids, Mich.*

Circle 309 on Reader Service Card

Subminiature Switch . . . has long life

A new switch mechanism, using stainless steel springs, prevents fatigue failures in the newly-developed Licon Type 15 subminiature switch. Mechanical life consistently exceeds ten million cycles. Some electrical test results are: 139,000 cycles @ 10 amp, 30 v dc, inductive; 950,000 cycles @ 5 amp 115 v ac, inductive; 22 million cycles

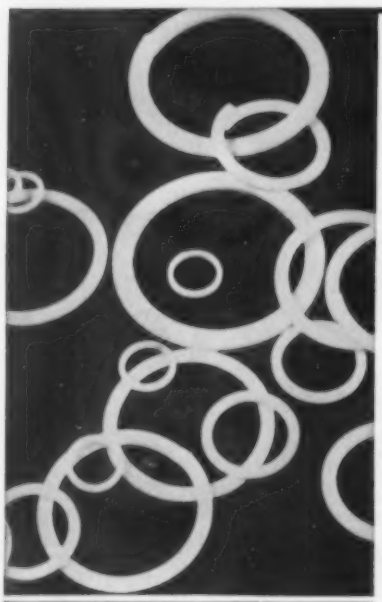
@ ½ amp 6 v ac and still running. Double-break contacts and four terminals may be used to increase electrical life and circuit connection possibilities. Vibration and shock resistance are excellent due to lightweight, short contact blades. Double-end plunger bearing makes direct cam operation possible. High overtravel and positive stop also eliminate the need for separate actuators. Switch measures 25/32 x 7/16 x ¼ in.—*Licon Switch Div., Illinois Tool Works, Chicago, Ill.*

Circle 310 on Reader Service Card

Pressure Transducer . . . is completely compensated

Model PT 45 pressure pickup incorporates compensation for sensitivity, zero balance, zero drift due to temperature, sensitivity change due to temperature, input impedance, and output impedance. This six-way compensation permits using the units interchangeably in a system or using them in a precalibrated system. Available in pressure ranges from 0-500 to 0-5000 psi, the units have maximum non linearity of 0.5% full scale, hysteresis of 0.25% full scale and repeatability of 0.1%

full scale. Operating temperature limits are —65 to 300 F with maximum temperature drift of 0.005% per deg F and temperature effect



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Circle 118 on Reader Service Card

Circle 127 on Reader Service Card

upon sensitivity of 0.005% per deg F. Pressure connection is for ¼-in AN flared tubing. The newly-designed four-active-arm unbonded strain gage unit has resistance of 350 ohm ±1%. Full scale output is 4.0 mv volt of excitation ±0.5%. Maximum excitation voltage is 10 v ac or dc. —*Dynamic Instrument Co., Cambridge, Mass.*

Circle 311 on Reader Service Card

Aircraft & Missile Filters

. . . data is given on line and in-line types, single and double cylinder wall, cell-type construction, and magnetic filter cartridge. Technical information is given on use of Poro-Klean as a filter medium and as an aero-dynamic material for boundary layer control and transpiration cooling. *Catalog No.* 54-100, *Cuno Engineering Corp., Meriden, Conn.*

Circle 312 on Reader Service Card

Air Compressor
. . . weighs 10.7 lb

Four-stage, piston type compressor can be combined with hydraulic motors, electric motors or mounted directly on an engine

pad. Designated MC 2003, the compressor has an oil capacity sufficient for 100 hours of operation. Bearings are of the frictionless type.—*M.C. Mfg. Co., Lake Orion, Mich.*

Circle 313 on Reader Service Card

Miniature Pressure Reducer
. . . weighs 4 oz or less

Designed for operation at pressures to 3000 psi in pneumatic service, this pressure reducer weighs from 0.17 to 0.25 lb de-

Continued on next page

Circle 139 on Reader Service Card

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George Keller is responsible for development, design, and testing of hydraulic systems and power servo-mechanisms for the flight control systems of missiles and inhabited aircraft.

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AVIATION COMPONENT DATA

pending upon the spring used and the amount of pressure reduction. Conforming to MIL-R-8572, A, it has ¼-in. ports Reducer may be supplied with or without an integral relief valve and is also applicable to hydraulic use. Completely balanced, it produces

straight line regulation with leak-tight shutoff, high rated capacity and small initial pressure drop under flow conditions. Normal temperature range is —65 to 225 F for pneumatics. Higher temperatures are possible with some internal modification.—*Pneu-Hydro Valve Corp., East Orange, N. J.*

Circle 314 on Reader Service Card

Filter Centrifuge Unit
. . . purifies and reclaims

Called the Centrifil, this unit incorporates a 40-micron filter, a centrifuge and two 2-micron fil-

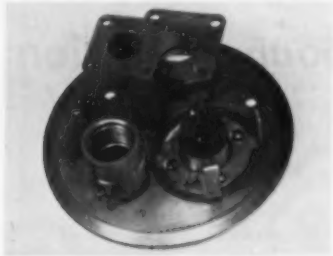
ters. Unit is said to remove practically 100% of both metallic and nonmetallic contaminants from both new and used fluids. Flow controls, pressure controls, pressure gages and sampling valves

are incorporated. Flow capacity is 1 gpm at maximum operating pressure of 100 psi. Filters will operate up to 50 hr without cleaning; centrifuge up to 100 hr. Three models are available. Model PSC is mounted on a three-wheel scooter that includes power plant and generator. This model is designed primarily for mobile use at airfields and missile sites. Model PC is four-wheel mounted with a trailer hitch. Model DC is dolly-mounted and is intended for in plant use.—*Permanent Filter Corp., Los Angeles, Calif.*

Circle 315 on Reader Service Card

Oil Tank Shutoff Valve
. . . resists 2000 F flame

Made of aluminum, except for the sump cover, this tank shutoff valve far surpassed CAA heat test requirements by being completely



operational after 32 min exposure to a 2000 F flame. Valve incorporates tank access door, drain valve, and bosses for a temperature bulb and an immersion heater. Designed for use on the Douglas DC-8 and the Lockheed Electra, the valve may be manually or motor actuated. It is produced in 1¼, 1½ and 2 in. line sizes with sump covers from 4 to 6 in. in diameter.—*Wm. R. Whittaker Co., Ltd., Los Angeles, Calif.*

Circle 316 on Reader Service Card

Accessories Test Machine

. . . designed for functional and operation testing of all types and sizes of aircraft and industrial hydraulic components, is completely described and illustrated. Machines handle variable flows up to 20 gpm and pressures up to 5000 psi. *Brochure HA-100, Greer Hydraulics, Inc., Jamaica, N. Y.*

Circle 317 on Reader Service Card

Torque Motor
. . . to actuate servo valves

Model 11 torque motor is designed primarily to stroke the flow controlling element in hydraulic or pneumatic servo valves. It will convert a few watts of input power

into a linear mechanical motion with force as high as 7.5 lb. Specifications are: maximum ambient operating temperature, 150 C; armature travel to 0.010 in.; size, 2.25 x 1.39 x 1.72 in.; output radius, 0..750 in.; moment of inertia, 27 micro-in.-lb.-sec^2; weight, 14 oz; hysteresis, less than 3%; sensitivity, 0.0005 in./ma and 0.1125 lb/ma; full stroke differential current, 20 ma; full force differential current, 40 ma; frequency response to 300 cps.—*Midwestern Instruments, Tulsa, Okla.*

Circle 318 on Reader Service Card

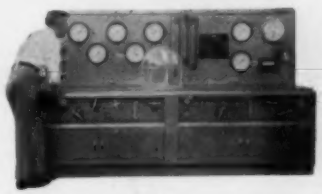
Sealing Co-Polymer
. . . may be bonded to metals

Newly developed compounded co-polymer is designated SR 251-70. It may be bonded to aluminum or other metals and has exceptional oil resistance. Bonded to metal it may be used for sealing poppets at temperatures as low as —65 F. For dynamic sealing, maximum recommended temperature range from 400 to 500 F depending upon duration of heating.

Material has excellent compression set properties at high temperatures and other physical properties such that the material is suitable for both static and dynamic sealing. It is superior to conventional elastomers in applications where extreme low temperature flexibility is not required.—*Stillman Rubber Co., Culver City, Calif.*

Circle 319 on Reader Service Card

TE-2



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SOME TERRITORIES OPEN FOR REPRESENTATIVES

PREVENT O-RING FAILURE...

.... by proper compound selection

• By E. J. Parker

ANY rubber, or rubber-like polymer is characterized by varying degrees of resistance to specific fluids and temperature tolerance, but its most valuable attribute is elastomeric memory. To make any of the polymers into usable engineering materials, it is necessary to reinforce or change properties such as hardness, modulus of elasticity, tensile strength, low temperature flexibility, high temperature resistance, etc., using 12 or 15 compounding ingredients. Between the polymers, compounding ingredients, and physical properties, it is obvious that the number of permutations is very large, and literally hundreds of O-ring compounds are manufactured to handle specific service environments.

Chart 1 lists the major classifications of O-ring compounds by the base polymer, major uses, and upper and lower temperature limits. This is no a substitute for expert assistance in compound selection for specific conditions, but only illustrates general uses.

• **Neoprene**—One fairly common mistake in compound selection is the generic use of "Neo-

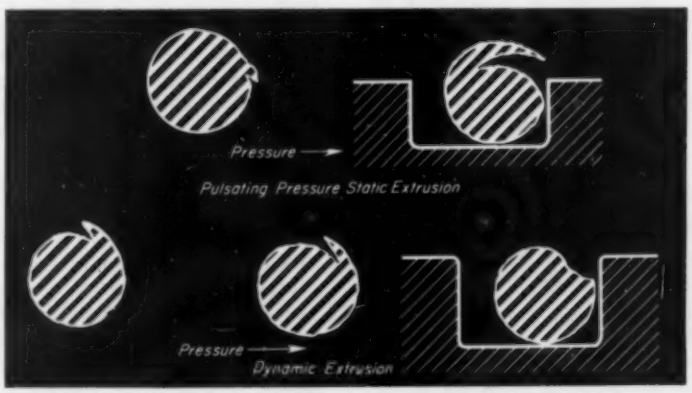


FIG. 1 WEAR starts as a peripheral groove slightly downstream from the median plane of the O-ring and gradually undercuts toward the downstream face.

E. J. PARKER, *Linear, Inc., Philadelphia*

CHART I—CLASSIFICATION OF O-RINGS BY COMMERCIALLY AVAILABLE BASE POLYMERS.

BASE POLYMER	MAJOR USES AS O-RINGS	TEMP. RANGES OF
Natural Rubber	Water and steam, silicone fluids, castor oil, alcohol fluids, many dilute aqueous chemical solutions. No oil present	—65 to +300 (steam) —65 to +212 (other uses)
Neoprene	Refrigerants, carbon dioxide, diaphragms, drive belts, accelerated aging from ozone, weather, sunlight	—65 to +160
Buna N Paracril Chemigum Hycar Butaprene	Petroleum lubricating and hydraulic oils, air, water, many chemicals, petroleum gases, petroleum fuels and solvents	—65 to +275
Thiokol	Solvents such as esters, ethers, ketones, alcohols, highly aromatic fuels.	—65 to +170
Butyl	Good chemical resistance, resist gas diffusion, suitable for phosphate-ester base fire-resistant fluids and other organic phosphates	—65 to +160
Buna S (GRS)	Good resistance to water, alcohols, and ketones	—65 to +160
Silicone	Low and high temperature resistance to air and inert gases. Vacuum seals. Oxidation, ozone, and weather resistance. Can be used with high aniline point oils for either low or high temperature. Usually static sealing only	—130 to +400 (constant) +500 (intermittent)
Acrylate	High temperature resistance to petroleum base oils and hydraulic fluids.	—20 to +325
Poly-FBA	High temperature resistance to diester lubricants, silicate ester hydraulic fluids, petroleum fuels and oils, organic phosphates, and many solvents.	—20 to +350/400
Teflon	Chemical resistance, high and low temperatures. Not an elastomer. Suitable only in limited types of applications.	—300 to +500
Kel-F and Fluorothene	Similar to Teflon. Better cold flow resistance, more limited chemical and temperature resistance. Same precautions apply.	—320 to +250
Kel-F Elastomer	As yet experimental and capabilities not completely known. Good resistance to fuming Nitric Acid.	—20 to +350
Vyram	Resistance to phosphate-ester base fire-resistant fluids, and other organic phosphates as well as petroleum base oils and fuels.	—20 to +250
Viton A	Broad gage fluid and extreme high temperature resistance	—20 to +500+

prene" as meaning synthetic rubber. Neoprene is only one of many synthetics and has unexcelled flexural life and very good aging and weathering characteristics. For oil and water hydraulic systems and petroleum fuels, Buna N compounds are used as their volumetric stability over a wide range of petroleum aniline points is much better than Neoprene.

• **Butyl compounds**—With very good chemical resistance, and the lowest gas diffusion rate of all synthetics, Butyl compounds have always been handicapped as O-ring materials because of very poor compression set characteristics. Recently, it has become possible to make Butyl compounds with 20 to 30% compression set, comparable to Buna N, and this should extend their usefulness considerably.

• **Silicones**—Chiefly valuable for excellent low temperature flexibility, high temperature resistance in air and dry gases, and very good compression set properties, they have been handicapped by excessive swell in most fluids. A new experimental silicone, LS-53, shows promise of removing this restriction with little loss of high temperature resistance. However, the abrasion resistance of silicones is low, so they are usually used only for static seals.

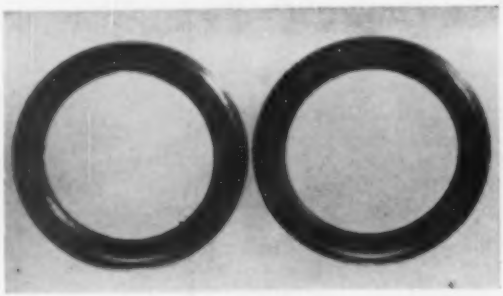
• **Fluoroplastics**—This group of fluorinated elastomers includes Poly FBA and Viton A, both of which are characterized by broad gage fluid tolerance and extereme high temperature resistance. Because of softening and re-molding tendencies at high temperature, O-rings of these materials must be treated somewhat differently. De-

sign and installation advice should be obtained from the O-ring manufacturer before attempting to use either type of compound.

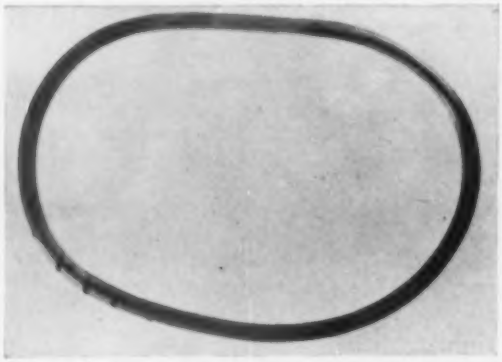
In spite of their chemical inertness, fluoroplastics have limited usage as O-ring materials because of the lack of elastomeric memory. A new material, Kel-F elastomer, which is a combination of Kel-F plastic and an elastomer, will remove this limitation for use with strong acids, including fuming nitric, for which no elastomer has previously been available.

• **Cost factor**—Developments continue to expand the materials and temperatures with which O-rings can be used. Practically all fluids except molten metals can be tolerated to some usable degree by exising rubber compounds.

Because of the wide variety of conditions for which O-rings are specified, it very often happens



"NIBBLING"—If side motion of the metal parts occurs while a portion of the O-ring is extruded into the gap, small chunks of rubber are pinched off. In static seals, extrusion failures may show up as cuts into the cross-section or as a thin ribbon of rubber sheared off the ring body.



"SPIRAL FAILURE"—When portions of the O-ring roll differentially with respect to each other, long-pitch spiral cuts result. Factors involved include: excess clearance, eccentricity of bore, cylinder breathing, inadequate lubrication, excessive side-loading. It is most frequent in long-stroke applications, and special effort should be made to insure concentricity.

that selection of the best compound for an application must be a compromise to effect the best balance of physical properties and price. For example, silicone rubber is usually recommended only for static O-ring seals because of its relatively poor abrasion resistance and low tensile strength. But, in a situation where a moving seal is subjected to very high oxidizing temperature and a limited amount of motion, silicone rubber might well provide the best compromise of properties.

Similarly, from examination of Chart 1, Poly FBA might be a logical choice for seals in a hydraulic product line because of its resistance to a wide range of fluids and excellent temperature resistance. However, it has the disadvantage of extremely high price and requires special designs. Hence, it is not a good compromise for general usage.

• **Temperature limitations**—Many situations with higher than approved limit temperatures can be tolerated by rubber compounds, depending on frequency and duration of exposure, type of atmosphere at the seal, etc. Similarly, some applications apparently demanding lower temperatures than listed for a given compound may be successfully met by that compound.

For instance, Poly FBA compounds have been used in aircraft engine sealing applications, which nominally call for —65 F operation, when an investigation of actual conditions showed that at the low limit no sealing was demanded and the only functional requirement at this temperature was that the O-rings not suffer permanent damage.

• **Environmental conditions**—It is common practice for designers to overstress the severity of environmental conditions to establish an additional safety factor for the seal application. In many cases this is not harmful, but it does sometimes impose a severe price penalty when the overstress carries the conditions from those suitable to one class of compound to some other type. For example, from Buna N to Poly FBA, where the price differential is one to five.

Actually, the penalty may be more severe than this, as substitution of compounds with exaggerated physical properties in one direction may cause loss of others equally important in the application. Similarly, the attempt to standardize on one compound to handle a wide range of environmental conditions, including the rare cases of maximum severity, often imposes a performance penalty on the majority of cases where conditions are not as severe.

• **Durometer**—Shorter seal life may result from indiscriminate use of higher Durometer compounds to compensate for higher pressure. In static seals without severe pressure pulsations, this is not a problem, but compounds above 70 Durometer lose many characteristics valuable for O-rings. If the same type of compound is hardened from 70 to 90 Durometer, there will be a loss of both elas-

Continued on page 156

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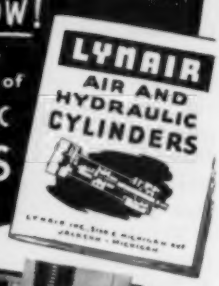

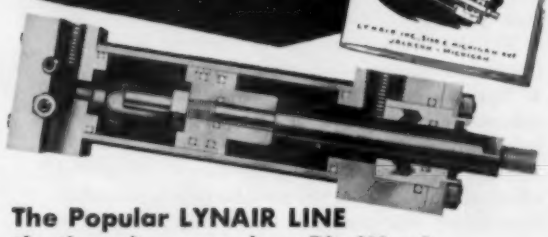

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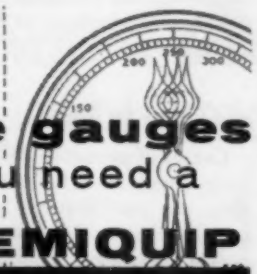

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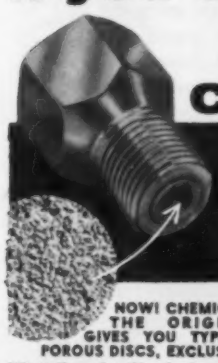

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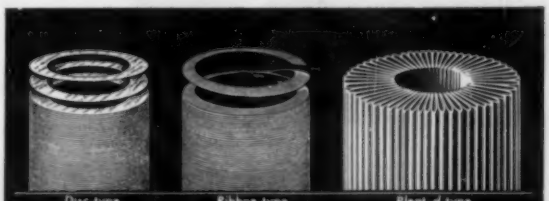

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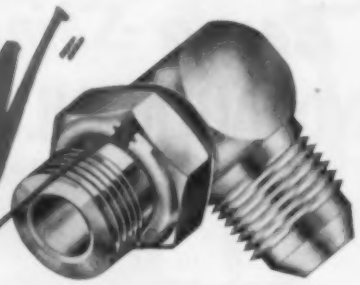
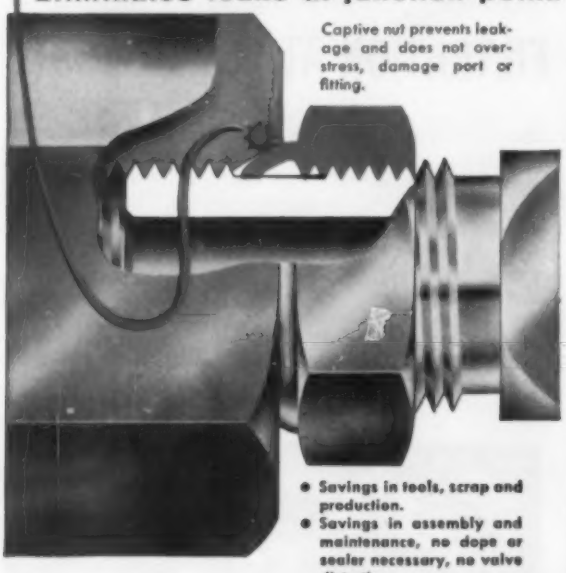


straight thread fitting

is your best answer to Costly Leakage because . . .

- L & L "CN" seals without use of "O" ring.
- Eliminates stress—elbows and tees can be positioned without overtorque of threads.
- Reduces installation time—no need for dope in your hydraulic system.
- Adapted to all hydraulic fluids.
- Assemble and reassemble without damage to port or fitting—assures positive seal.
- *VIBRATION AND HEAT RESISTANT*

Eliminates leaks at junction point.



Captive nut prevents leakage and does not overstress, damage port or fitting.

- Savings in tools, scrap and production.
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PREVENT O-RING FAILURE

Continued from page 154

ticity and stress life and an increase of compression set.

In any flexing O-ring application, such as a reciprocating dynamic seal, or a pulsating static pressure seal, the life will be shortened with higher Durometer, along with higher friction in a moving seal. For these reasons, it is preferable to obtain high pressure extrusion resistance by closer fits or anti-extrusion rings, rather than by increasing Durometer of the compound.

● **Specify conditions**—Many times O-rings are ordered without reference to compound or usage. In such cases the manufacturer will usually supply a commercial Buna N oil hydraulic compound, which may not be at all suitable for the application. Many seal problems could be eliminated if,

Specifying proper compounds for O-rings can prevent . . .

- ***Excessive swelling***
- ***Shrinkage***
- ***Hardening***
- ***Loss of material***

when the proper compound is not known from previous experience, the purchase order stated the type of application, operating conditions, and fluid involved. Then the order would be cleared through the chemical department and a suitable compound specified.

O-RING FAILURE

Causes of premature O-ring failure are many and varied, and most failures are the result of more than one contributory factor. However, we can broadly classify these causes into three basic categories: overstress, compound selection, and mechanical failure.

● **Overstress**—Abrasive wear of a rubber compound is greatly accelerated by overstress on the compound at the rubbing contact area. The O-ring has an inherent high extrusion resistance because as the ring is deformed toward the downstream sidewall of the groove the rubber compound is put under increasing stress and tends to resist further deformation. As long as this deformation is limited to reshaping of the cross-section into approximately rectangular shape, the increase in wear rate is not serious. However, if the combination of pressure, modulus of the compound, and width of the downstream clearance gap allows movement of the rubber into gap, the degree of stress and rate of abrasive wear is greatly increased.

In a reciprocating seal, or a static seal where pressure pulsations and gland design allow excessive axial motion of the ring, this wear starts as a peripheral groove slightly downstream from the

Concluded on page 158

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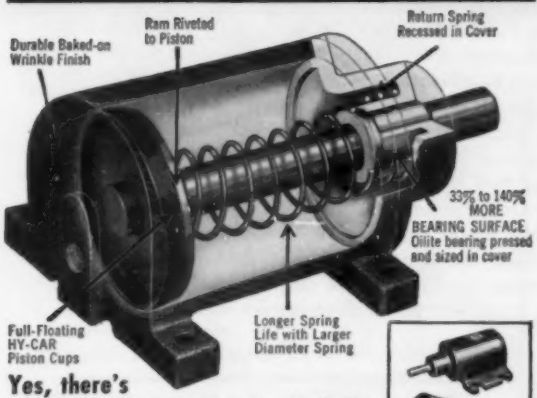
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33⅓ to 140% MORE BEARING SURFACE Oilite bearing pressed and sized in cover
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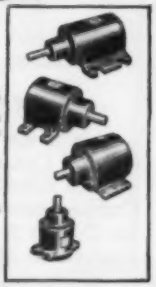

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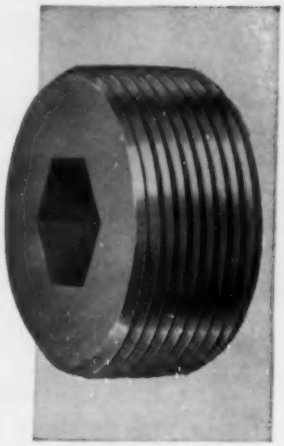

Use them wherever liquids or gases must be contained under pressure—or in place of ordinary pipe plugs. UNBRAKOs seal without compound. They are made of the same high-strength alloy steel, have the same internal wrenching feature as UNBRAKO socket screws. Fully formed threads exceed NPTF specifications. Standard sizes—⅛ to 1¼ in.—are stocked by your authorized industrial distributor. See him for details. Or write Unbrako Socket Screw Division, STANDARD PRESSED STEEL Co., Jenkintown 2, Pa.

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GD 80	0-5000	Accurate Valve Control. —67° to +160° F. Range.	
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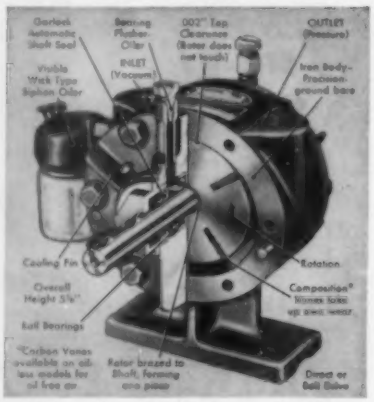
HEAVY-DUTY PUMPS
To 21 cfm, 28" vac. or 30 psi.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PREVENT O-RING FAILURE

Concluded from page 156

median plane of the O-ring and gradually undercuts toward the downstream face. This is shown in Figure 1. Finally, a portion of the rubber is separated from the balance of the ring. The degree to which this can be tolerated depends on the type of seal. Leakage obviously occurs earlier in a double-acting reciprocating seal, where the worn portion of the ring may be rolled across the sealing face at pressure reversal.

One type of failure results when the stressed O-ring passes over scores or scratches in the bore. Under stress conditions fine grooves may be cut across the face of the ring. Under high pressure a relatively minor leak across such a groove is actually a high velocity stream in the groove itself, which erodes away rubber, resulting in major leakage.

More On O-Rings

This is the last in a series of three articles on O-rings by E. J. Parker. Previous articles were: **How O-Rings Seal Air & Oil Components**—May; and **How to Design for O-Ring Seals on Air and Oil-Powered Equipment**—June.

• **Compound failure**—Excessive swelling is accompanied by softening of the compound, and this combination makes the O-rings more susceptible to abrasive wear and extrusion, and may actually force rubber into the clearance gap, resulting in a sort of artificial extrusion failure.

Shrinkage may cause complete loss of squeeze, resulting in increased leakage, or sudden, complete loss of sealing.

Hardening occurs when a compound is used at temperature above its top limit, resulting in loss of elastomeric memory.

Less frequent is actual loss of material, caused by chemical attack by the fluid, such as occurs when silicone compounds are used with steam as the fluid.

• **Mechanical failure**—This includes differences between drawing and finished part, careless parts handling, improper installation and assembly techniques, and designer's lack of experience or knowledge of O-ring requirements.

Certainly, a good design must start on the drawing board, but unless the shop is able to translate the drawing to parts in accordance with the tolerances and surface finishes called out, even a well-planned design will encounter difficulties.

A study of an O-ring manufacturer's design manual is highly recommended before proceeding with fabrication of actual parts. ▼▼▼

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Self-adjusting, easy to install, Seal-Guard's knife-like bronze rings "wipe off" all dirt and grime, will not mar the rod, are oil and heat resistant and friction-free.

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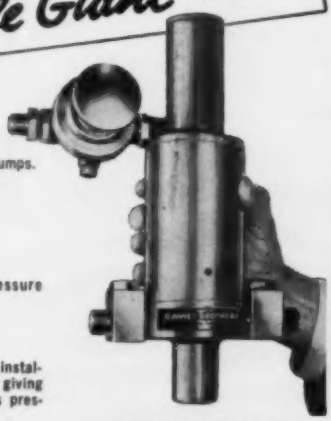

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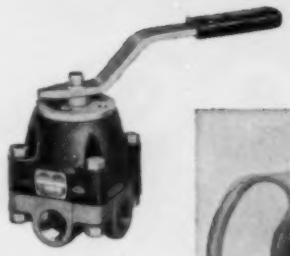

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Note the mirrorlike sealing surfaces on this Dual Pressure Valve rotor after 4 years of service.

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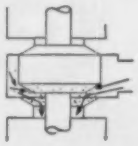
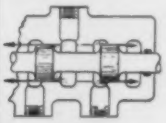


Poppets score



Spools leak

Write for Bulletin W-5.

BARKSDALE VALVES

5125 Alcoa Avenue, Los Angeles 58, California

Circle 17 on Reader Service Card

FIRE-RESISTANT HYDRAULIC FLUIDS

Part 5—Change-over Practices

• By Charles R. Schmitt

Manager, Lubrication Department
E. F. Houghton Co.,
Philadelphia, Pa.

WITH increased use of fire-resistant hydraulic fluids, their service characteristics are better understood, as well as problems involved in change-over from petroleum oils. There are two main causes of trouble—incomplete preparation, and mechanical deficiencies in the system, such as inadequate pump porting. Special considerations necessary for both aqueous and non-aqueous fluids are given in the table.

• **Paint Removal**—It is necessary to remove any type of oil-resistant paint which would come in contact with the fluid. All fire-resistant fluids tend to soften and peel off the paint, which may enter the hydraulic circuit and interfere with operation.

Removal is frequently difficult, requiring hand scraping following use of paint remover. Caustic fluids, mixed with hot water, attack and remove paint. Allowing steam to bubble into the caustic until the reservoir is filled keeps the solution hot and makes it more active. After using, the solution is drained. Normally, the paint removed can be drained off with the fluid. The reservoir must then be rinsed thoroughly until no trace of alkalinity remains (litmus paper test).

Certain paints resist the action of water-base fire-resistant fluids. Also, some plastic sealing compounds and pipe joint compounds are impervious to these fluids.

Drain all parts of the system. In the case of low points, where drainage is not normally possible, connecting joints should be broken, cleaned and drained individually. This includes such items as valves, elbows and accumulators.

With phosphate type fluids, all oil residue must be removed from the system, as oil is soluble in phosphate ester material. More than 1% residue could impair the fire-resistant qualities. If possible, push out all traces of oil with low pressure air. Hand wiping of the reservoir is essential.

Where the systems are so complex and inaccessible that actual draining and hand wiping are not possible, the fluid itself can be used as a flushing medium. Under such circumstances, the fluid should be allowed to circulate for several hours until it is hot enough to do a good job of cleaning. During this period, any paint which is in the reservoir will be loosened and most of it can be removed. If it is impossible to get at the reservoir to remove the paint, this flush of the phosphate material must be continued until the paint peels off and is carried to the filters by the fluid.

This fluid used for flushing can be stored for similar use in other machines.

• **Packings**—Non-aqueous fluids will harm packings compatible with petroleum oils. Static seals will swell in time, but this may not have a serious

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10	27	44	61	78	95	112	129	146	163	180	197	214	231	248	265	282	299	316	333
11	28	45	62	79	96	113	130	147	164	181	198	215	232	249	266	283	300	317	334
12	29	46	63	80	97	114	131	148	165	182	199	216	233	250	267	284	301	318	335
13	30	47	64	81	98	115	132	149	166	183	200	217	234	251	268	285	302	319	336
14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303	320	337
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304	321	338
16	33	50	67	84	101	118	135	152	169	186	203	220	237	254	271	288	305	322	339
17	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306	323	340

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15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304	321	338
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Steps Required for Preparation of Hydraulic System When Changing to Aqueous Base Fire-Resistant Fluid

1. Completely drain system of previous fluid:
   - Reservoir
   - Accumulator
   - Coolers
   - Lines
   - Cylinders
2. Disconnect and remove filters and intake pipe strainers.
3. Wipe reservoir dry with lint-free rags. If there is paint on inside surface, remove by commercial paint remover or hot caustic.
4. Reconnect system; clean and reinstall intake strainers.
5. If petroleum oil was previously used—
   (a) Fill machine with light hydraulic oil
   (b) Operate machine for 20 min
   (c) Pump out sump; drain all accumulators, cylinders and coolers.
   (d) Wipe reservoir clean.
6. Fill with fire-resistant fluid—including accumulator.
7. Install filter.
8. Cycle machine for 10 min.
9. Check reservoir level; if low, fill to level.
10. Check all piping for leaks, and tighten if necessary.
11. Attach "Caution" tag to the fill pipe.

If Aqueous Base Type is Replacing Another Type of Fire-Resistant Fluid—Note These Further Precautions:

1. After careful draining, fill machine with a warm water solution (100-1) of flushing concentrate recommended by the supplier.
2. Set pressure control valve at 50-75 psi.
3. Cycle machine for 20 min.
4. Drain and wipe clean.
5. Clean intake strainers and reinstall.
6. Reset pressure control valve to normal setting.
7. Check pump for previous wear.

If Phosphate Base Fluid is Replacing Hydraulic Oil All residual petroleum oil must be thoroughly removed; otherwise it will be dissolved in the ester and lower the fire resistance.

1. Drain system as specified.
2. Clean reservoirs as specified.
3. Blow lines clear with dry low-pressure air.
4. Pump bodies and large valve bodies should be opened and swabbed dry by hand.
5. If bladder-type accumulators are used, replace bladders with butyl rubber type.
6. All low points in piping system must be opened and drained.
7. All filters and strainers must be removed and cleaned.
8. All paint must be removed from internal surfaces.
9. Replace leaking seals; install special dynamic seals if type now used is affected by fluid.
10. Reassemble and connect components.
11. Fill system with phosphate ester fluid.

effect on the system as they will simply swell and tighten up in the aperture. However, if portions of the system containing these seals are dismantled, it will then be necessary to replace them with new seals compatible with non-aqueous fluids.

In dynamic seals such swelling will cause them to tighten and rub on the moving parts to the point where premature wear or failure might occur. It is better to replace these seals during change-over. Accumulators using a rubber bladder should be changed to a butyl rubber bladder.

The water based fluids do not adversely affect seals. In some pumps, cork impregnated rubber gaskets are used as sealing material, and these should be replaced with mechanical rubber type.

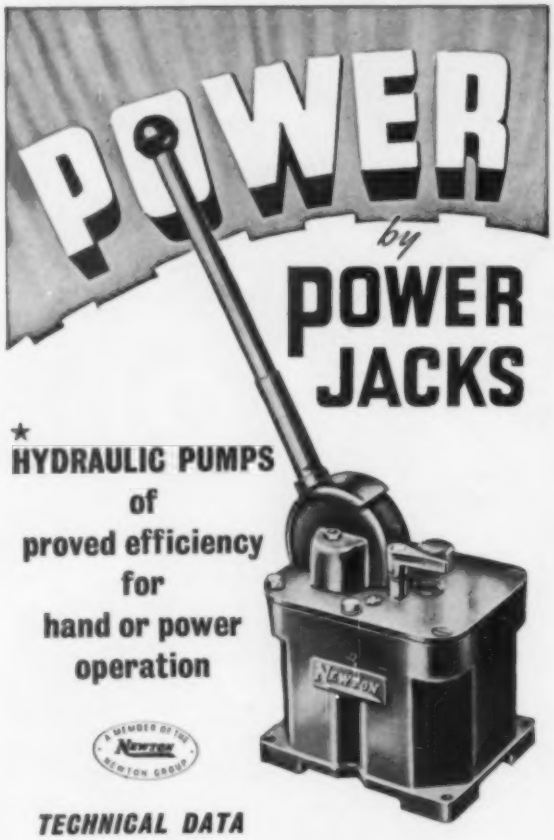
• **Fluid Flow**—All fire-resistant fluids have higher specific gravities than petroleum oil hydraulic fluids. Since most pumps are designed for use with petroleum oils this can result in unsatisfactory fluid flow. Some pumps are now being redesigned to permit streamlined fluid flow at all pressures. Trouble can easily occur in intake flow, as it is necessary to have sufficient flow in the pump entry, which is provided by the force of atmospheric pressure. Therefore, piping between the reservoir and the pump should be minimized, and the intake should be at a minimum distance above the fluid level. One manufacturer recommends a vacuum of less than 5 inches of mercury at the inlet port. Above this vacuum, it would be necessary to decrease the distance between the oil level and the pump. Sometimes, if the reading is only slightly off, this may be corrected by using a larger size pipe into the pipe into the intake. If everything else fails, the speed of the pump should be decreased to provide a lower displacement.

• **Strainers**—Normally, intake strainers vary in mesh size. To insure good intake conditions a mesh of 60 or less should be used, as anything smaller interferes with good, smooth flow into the pump. With water base fluids, these screens should not be coated with cadmium or zinc as these materials are adversely affected.

Nickel-plated filters are now available at no extra cost. Magnetic-plug assemblies placed in the reservoir near the intake pipe will trap steel particles.

• **Fluid Cooling**—In the case of water-base fluids, temperatures above 130 F in the reservoir tend to dissipate water too rapidly. When system fluids are subjected to such temperatures, they thin down too much for good operation. For this reason, heat exchangers are recommended to control sump temperatures.

• **Oil Film**—Removal of oil film from the reservoir surface of an aqueous fluid installation per-



TECHNICAL DATA

Normal operating pressure . . 1,500 lbs. sq. in.

Maximum operating pressure (Blow off) . . 2,500 lbs. sq. in. (*or to specification*)

Output complete stroke . . . . . ·825 cu. ins.

Effective piston area . . . . . ·600 ins.

Handle leverage ratio 16-1

Alternative fluid capacities in pints . 2¾ pts., 6 pts., 16 pts., 24 pts., 32 pts.

Larger capacities to special order.

Vertical or horizontal pump handle.

JACKS from 1 TON to 5 TONS in a variety of stroke lengths

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POWER JACKS *LIMITED*

VALETTA RD·ACTON·LONDON·W.3·ENGLAND

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mits more rapid escape of air or gas bubbles, which aids in obtaining optimum pump performance. When samples after fluid installation reveal a definite petroleum oil content, it is apparent that no serious effort has been made to skim off the oil from the surface.

• **Pumps**—Careful examination is necessary to see that the sealing elements are proper and of the latest design so that all air leakage into the pump is eliminated. The manufacturer should be consulted at each change-over to make certain that all phases are properly handled.

When a water-base fluid is being installed, the pump lubricant should be considered. Where grease is applied through a fitting, the soda-base type normally used when oil is the medium should be replaced by a water-resistant grease, or mixed base type. Any leakage of the hydraulic fluid past the shaft seal into the bearing will emulsify the grease. Besides, entry of air will cause vibrations inside the pump, resulting in premature wear and lesser pump life. Tests show that aluminum, calcium and lithium base greases work well in such cases.

It is often necessary to check samples of fluid from the reservoir periodically to see if contamination has occurred, and whether fluid is being used properly.

• **Water Content**—It is often necessary to replenish the water content which is depleted in varying degree according to the temperature of operation and equipment design. In normal, well-designed systems, temperature can be controlled in line with JIC recommendations of less than 130 F. Under such conditions, and where the only chance for the escape of vapor is through the fluid intake breather, water evaporation from the tank is very low.

Water content is gauged by changes in viscosity. Chemical decomposition of water-base fluids is caused by contamination, malfunctioning of the hydraulic system, or failure of the water cooler to control temperature. Extent of this can be determined by check of the pH. Any pH reading outside of recommended limits should be checked with the manufacturer for steps to be taken. pH can be measured with Hydrion papers.

Water-base fluids should never be used in magnesium die-casting machines, nor in the presence of molten magnesium.

Water in normal amounts, such as from condensation, can be tolerated by water-base fluids. Water from condensation or contamination will float on top of phosphate ester base fluids, and can be skimmed off.

Petroleum oil mixes poorly with water-base fluids and can be skimmed off. However, it is completely soluble in phosphate base fluids, and every precaution should be taken to keep oil out. It can be removed from the phosphate fluid by centrifuging. Usually, 1% or 2% of oil can be tolerated. ▼▼▼

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FOR "FLIP-TOP" Action!

HOKE TOGGLE VALVES

A flip of the handle is all it takes to open or close a Hoke toggle valve, providing fast, positive control on gas or liquid lines at pressures up to 1000 psi. Seats and stem seals are tight enough for most vacuum work. For instrument panels or test stands, in angle and globe patterns of brass or stainless. Sizes ⅛" through ½", handles are colored for quick identity. Complete data is yours for the asking.

HOKE

HOKE INCORPORATED
Fluid Control Specialists
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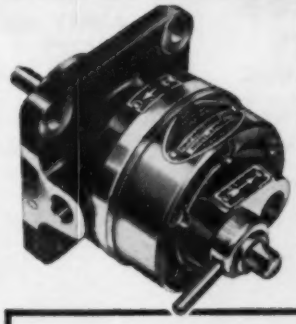
SAVERY ANNULAR PISTON PUMP



Infinitely variable from maximum output down to zero. Working pressures up to 1500 p.s.i. Fixed delivery models also available.

This compact rotary pump without Gears, Valves, Vanes or Springs is of unique design and simple in construction.

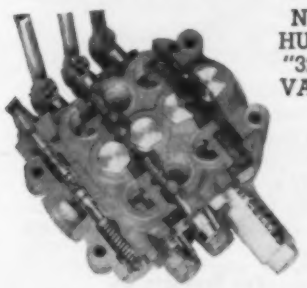
The pump has the following desirable characteristics:

- Volumetric efficiency as high as 99%
- Absolute positive action and steady uniform flow at slow speeds
- No aeration or turbulence of the fluid
- The path of the fluid through the pump is unidirectional and the internals are constantly swept by the fluid
- No idle pockets or passages to cause air locks or allow coagulation
- Completely self-lubricating, ensuring capacity to run for long periods without attention
- Leakproof

U. S. and CANADIAN AGENT
DAVIES BROS., GLADSTONE, NEW JERSEY

Thomas Savery Pumps Ltd., Birmingham, England

THESE HUSCO HYDRAULIC VALVES OFFER *SPECIAL* POWER CONTROL BENEFITS



NEW HUSCO "3200" VALVE

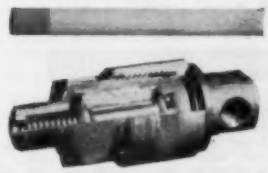
Power-Saving • Multi-Position

You'll find unlimited application for this new "3200" Husco Valve. Here are some features:

- Choice of ONE to SIX plungers, with sealed ends—in completely balanced design.
- FOUR Control Positions—raise, lower, float, neutral—with or without detent.
- Pilot-Operated Relief permits setting to maximum of 50 lb. variation—for substantial H.P. savings.
- Accurated rated capacity—35 G.P.M.—with high pressure carryover.

HUSCO "3070" Selector Valve for Two-Line Sequence Control

Unusually compact, space-saving, precision-machined, the HUSCO "3070" provides instantaneous adjustment for either of two fluid lines. Available in two sizes—for capacities up to 30 and 60 G.P.M.



HUSCO "4000" Rotary Swivel

This low cost, highly efficient Rotary Swivel is widely used for both high pressure and high operating speeds, particularly in the brake and clutch field. Compact, for use in close quarters. Has spring-loaded Teflon rings, self-centering ball thrust bearing, highly efficient axial bearings. Size, only 3" x 1½". Other sizes available.

HUSCO

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Husco Hydraulic Products are engineered primarily for the rugged demands of Construction, Industrial and Materials Handling Equipment. They are noted for their space saving, cost saving and positive operational control features. Write for detailed specifications or information.

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P. O. Box 257-A

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NEW!

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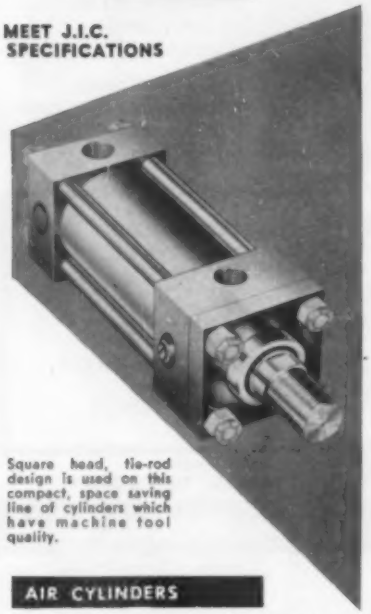
HEAVY-DUTY
AIR and HYDRAULIC
CYLINDERS

MEET J.I.C. SPECIFICATIONS



Square head, tie-rod design is used on this compact, space saving line of cylinders which have machine tool quality.

AIR CYLINDERS

Precision designed for heavy duty service ● 1-½ to 14-in. bore ● all steel with honed brass cylinder barrel ● single or double rod ends ● 13 different mountings ● interchangeable mountings and rod end style with any other leading cylinder manufacturer ● cartridge type piston rod bronze bearing ● adjustable cushions ● aluminum alloy one piece piston ● self regulating, wear compensating seals.

HYDRAULIC CYLINDERS

All steel ● 2000 to 3000 psi service ● 1-½ to 12-in. bore ● single or double rod ends ● 15 different mountings ● cylinder barrels honed to 10 micro-inch finish ● one piece precision alloy iron piston ● alloy step-cut piston rings ● cartridge type piston rod bearing ● adjustable cushions ● interchangeable mountings and rod end styles with any other leading cylinder manufacturer.

We also build special cylinders.
Select territories still available to qualified representatives.

Milwaukee Cylinder Co.
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A-100 Pneumatic Cylinders ☐
B-100 Automatic Standard Air Cylinders ☐

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City ..... Zone ..... State .....

'milwaukee' CYLINDER COMPANY
DIVISION OF L & M MACHINE CO.

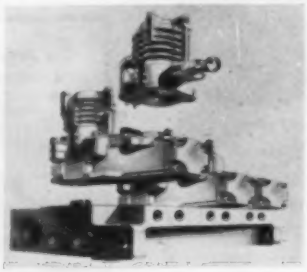
New Products / continued

4-WAY AIR CONTROL VALVES

. . . are plug-in type

Designation: Speed King

Specifications: Available in single and double solenoid types, for manifold or sub-base mounting. Units have plug-in connectors built into pilot, valve body and manifold or sub-base complete electrical connec-



tions as components are bolted in place. Units feature aluminum bodies, manifolds or sub-bases, end caps, spacers and pistons; hard chrome plated stainless steel stems; Fabreeka-backed stainless steel shock pads and O-ring packers. Valves are for 30 to 250 psi air. Port and mounting locations of single and double solenoid types are identical.

Valvair Corp.
Akron, Ohio

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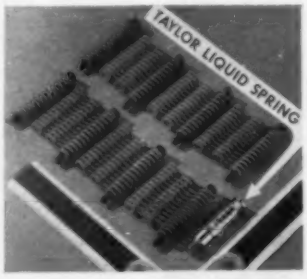
MINIATURE LIQUID SPRING

. . . uses hydraulic levering

Designation: Model 416

Features: Unit uses internal hydraulic levering principle to pro-



duce 20 times the force of a standard coil spring of same diameter and length.

Specifications: Using liquid compressibility, this ½-in. dia., compact, self-contained liquid spring develops 800 lbs force at ¼-in. stroke with an 80-lb preload. Unit is only 2-in. long, plus ⅜-in. mounting stud. Available with standard ⅜-24 mounting thread.

Taylor Devices, Inc.
North Tonawanda, N. Y.

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LARGE DEHUMIDIFIER

. . . gives low dewpoint air

Designation: Vi-Speed Dehumidi-Filter Model 5000

Features: With a capacity of 1700 scfm at 100 psi, these units furnish low dewpoint air for instrumenta-

tion and other demanding uses. Air users having up to 425-hp compressor output can filter their entire air supply at one central location, eliminating the maintenance of numerous small filters throughout their plant.

Van Products Co.
Erie, Pa.

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TEST STAND

. . . is self-contained

Designation: Porta-Tester

Features: Unit is a bench-type hydraulic and pneumatic test stand, for use wherever pressure equipment must be tested without an external source of power. Unit is self-contained, low-cost and easily

portable. It can be operated by anyone without previous training. This unit tests safety and relief valves, globe, gate, plug and other valves, pressure vessels, piping and pump

cases. It is suitable for liquid testing up to 3000 psi. Tester is furnished with mounting adapters, hand pump gauges, and an air connection is provided for seal leakage testing.

Farris Engineering Corp.
Palisades Park, N. J.

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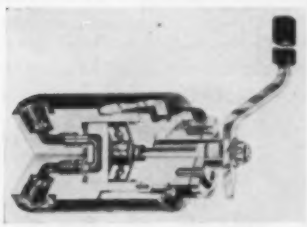
FOUR-WAY VALVE

. . . for 10,000 psi

Specifications: Available in pipe sizes from ¼ to 1-in., but may be obtained with tube, AND 10050, or any preferred special high pressure connection. Valve will withstand surges up to 15,000 psi with-



out damage to sealing qualities, and is designed for burst pressure of 30,000 psi. Uses shear-seal principle, with lapped optically flat metal-to-metal surfaces on sealing rings and mating rotor face always in contact. Flow travels only through the center of the shear-seal, never across sealing surfaces.

Barksdale Valves
Los Angeles, Calif.

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CONTROL VALVE

. . . is diaphragm operated

Features: Designed for automatic control, valves are suitable for use in air, oil, or water service, at pressures to 6000 psi. Resistance to cor-

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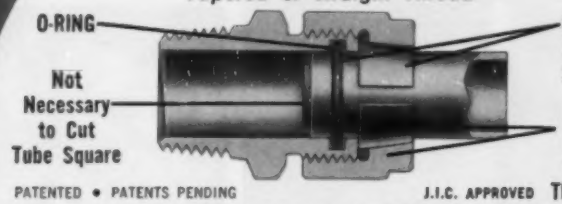
LENZ COMPANY

A Complete Line of Fittings and Connections for any Type of Piping Application . . .

Featuring LENZ O-RING TUBE FITTINGS

Tapered or Straight Thread



PATENTED • PATENTS PENDING J.I.C. APPROVED

NO METAL TO METAL SEAL!
NO EXACT TUBE LENGTH NECESSARY!

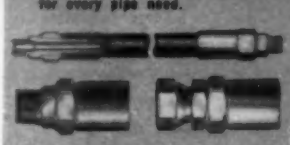
Lenz fittings seal with standard, stock O-Rings. At zero pressure the initial compression furnishes necessary sealing force . . . the higher the pressure the tighter the seal. Every joint becomes a union!

LENZ FITTINGS pay for themselves over and over again by reducing installation and maintenance costs. . . only a hacksaw and a file needed . . . no periodic tightening . . . remain leakproof and reusable no matter how often reassembled . . . Ideal for all tubing on hydraulic, air or vacuum systems.

New LENZ PRODUCTS

PIPE FITTINGS

A complete line of connectors, elbows, crosses, tees, bushings, couplings, nipples and plugs . . . for every pipe need.

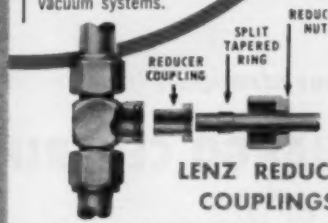


HOSE FITTINGS

Perfectly matched hose assemblies . . . a full line of re-usable fittings and hose lengths in low, medium and high pressure ranges.

AIR BLEEDER VALVES

Compact, functional . . . only two metal parts . . . no packings. Maintain maximum operating efficiency by eliminating air from lines.



LENZ REDUCER COUPLINGS

Makes possible line reductions on any leg by use of standard adapters and adapter nuts. Eliminates large inventory of special fittings and possibility of obsolesence from engineering changes. Full range of sizes.

OTHER LENZ PRODUCTS

In addition Lenz manufactures and supplies a full range of sizes in HYDRAULIC TUBING . . . INDUSTRIAL HOSE . . . STEMS and JOINERS . . . DEBURRING CUTTERS . . . TUBE CUTTERS . . . and TUBE BENDERS. See our ad in Thomas Register, under Fittings: Hydraulic, for complete listing.

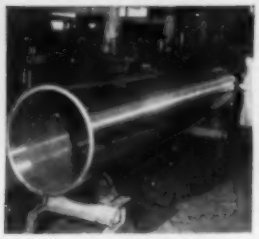
Free! Write For newly released LENZ catalogs for complete product line and sizes on above products . . . Ask to be put on our mailing list.

Representatives In Principal Cities

LENZ COMPANY

3303 Klepinger Road
DAYTON 1 • OHIO
Phone: CRestview 7-9364

Circle 78 on Reader Service Card



You get stronger, longer-lasting components with

SHENANGO CENTRIFUGAL CASTINGS

Even under the severest hydraulic service, you'll always get peak performance from Shenango centrifugally-cast components. They have a uniform, *pressure-dense* grain which makes for unusual strength and wearability. They are remarkably free from inclusions and porosity. And you'll find a *minimum* of machining is needed to attain a *maximum* of finish.

Shenango offers you cylinders and all symmetrical components in a wide range of sizes, shapes and dimensions . . . in most any non-ferrous metal or tough Meehanite metal . . . and rough-machined *or* finished to your exact specifications.

Shenango also offers a broad range of centrifugally-cast tubular bar stock to meet standard *and* specialized requirements.

For the full story on Shenango's modern centrifugal casting process and products, write to: *Centrifugally Cast Products Division,* The Shenango Furnace Company, Dover, Ohio.

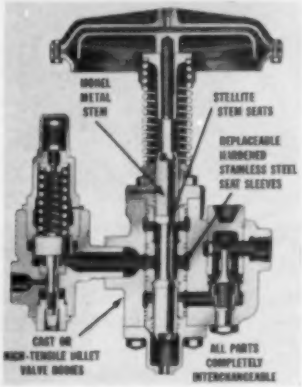
SHENANGO CENTRIFUGAL CASTINGS

COPPER, TIN, LEAD, ZINC BRONZES • ALUMINUM AND MANGANESE BRONZES
MONEL METAL • NI-RESIST • MEEHANITE® METAL • ALLOY IRONS

Circle 121 on Reader Service Card

New Products continued

rosion is assured by the monel metal valve stem, hardened stainless steel seat sleeves and valve bodies of cast Navy-M bronze or hi-tensile alloy billet bronze. Stellite seats are


MONEL METAL STEM
STELLITE STEM SEATS
REPLACEABLE HARDENED STAINLESS STEEL SEAT SLEEVES
CAST OR HIGH-TENSILE BILLET VALVE BODIES
ALL PARTS COMPLETELY INTERCHANGEABLE

electro-bonded to the monel stem, and stainless steel seat sleeves are easily replaceable.

Sinclair-Collins Valve Co.
Akron, Ohio

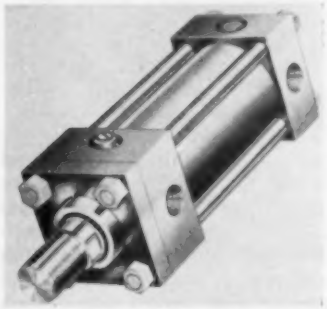
Circle 193 on Reader Service Card

HEAVY DUTY AIR CYLINDERS

. . . feature compactness

Designation: Series A

Specifications: Precision designed for heavy-duty service, and conform to JIC specifications. Unit is all steel construction with brass cylin-



der barrel. Available in bore sizes 1½ to 14-in. for 200 psi service. Units are single or double-action with cushions on one or both ends.

Milwaukee Cylinder Co. Div.
L & M Machine Co.
Cudahy, Wis.

Circle 194 on Reader Service Card

BOOTS & SLEEVES

. . . made from Teflon

Features: Protective covers fabricated from Teflon withstand temperatures to 500 F without decom-

position or objectionable surface rack. Accordion sections are formed with flame-resistant, specially treated cord, permitting the convolutions to flex normally on their double-thick seams.

Specifications: Material has good dielectric strength over a wide range of frequencies and temperature extremes, and takes rapid flexing on delicate test instruments and small piston rods.

A & A Mfg. Co., Inc.
Milwaukee, Wis.

Circle 195 on Reader Service Card

PNEUMATIC ACTUATORS

. . . use diaphragm control valve

Design: Units use split-coupling which joins the actuator spring stem to the valve plug stem. Stems do not engage and do not meet. Actuator can be completely removed without disturbing the packing box bolting.

Specifications: Coupling has left

hand upper and right hand lower threads, is a twist-proof clamp for joining the stems, and acts like a turnbuckle for adjustment of plug seating tension. Actuators are available in three standard sizes, with each size covering twelve different constructions. Three spring ranges —3-15, 5-25, and 6-30 psi—are interchangeable in each size and type.

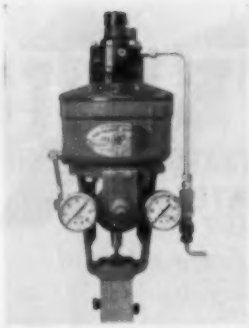
Hammel-Dahl Co.
Providence, R. I.

Circle 196 on Reader Service Card

PROPORTIONING CONTROL VALVE

. . . has removable orifice seat

Features: Designed for greater accuracy with a longitudinal stem lift in line with the piston. When installed with line air pressure up to 100 psi, it provides accurate and



safe automatic or remote control.

Specifications: Unit has a removable orifice seat, and is available in sizes ⅛ to ¾-in., for pressures from 6,000 to 30,000 psi. Can be specified to meet explosion-proof requirements, and in all types of materials. Can be supplied in a complete package with electronic pressure sensing device for completely automatic operation.

High Pressure Equipment Co., Inc.
Erie, Pa.

Circle 197 on Reader Service Card

Continued on next page

CARDWELL ELECTRIC-HYDRAULIC CONTROLS

Cardwell has specialized for many years in the interpretation of specific problems in design and execution of control panels and consoles, paying particular attention to space requirements and ease of access to components.

Do you have a problem for us to solve?

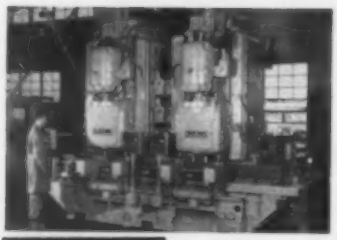
The **CARDWELL MACHINE COMPANY**
Franklin at 19th St., Richmond 11, Virginia • Phone 7-4593

Circle 26 on Reader Service Card

Circle 23 on Reader Service Card

TARGET!!

HIGHER PRODUCTION THROUGH EFFICIENT HYDRAULIC MAINTENANCE



free manual tells how

RELIABLE MACHINE BUILDERS LIKE SUNDSTRAND AND MACHINE USERS, LARGE AND SMALL FIND that low cost filters placed in the correct locations step up production. Sticking valves, stuck spindles and corrosion troubles are reduced to lowest minimum. Operators find their work goes smoother. Cuts "down-time" AND SLOW TIME costs.

Briggs — PIONEERS IN MODERN OIL FILTRATION

HYDRAULIC OIL FILTERS

PRODUCT OF PUROLATOR RESEARCH

THE BRIGGS FILTRATION COMPANY
DEPT. 209, WASHINGTON 16, D. C.

YES! Send me your complete hydraulic production manual.

NAME .....

COMPANY .....

ADDRESS .....

ON THE JOB...

WITH RUGGED HEAVY-DUTY HYDRAULIC CYLINDERS

Three heavy-duty CROSS Hydraulic Cylinders provide power and control, on this rugged loader . . . built by GECO, INC., Denver, Colo. For long-lasting, leak-proof dependability . . . you can rely on CROSS CYLINDERS in any operation!

Immediate delivery on any quantity, at lowest price per unit for O. E. M.

Our engineers work free, to help figure job specifications.
Catalog available on request —

HYDRAULIC CYLINDERS — CROSS MFG. CO. — CROSS — LEWIS, KANSAS — MADE IN U.S.A.

WRITE...WIRE...PHONE

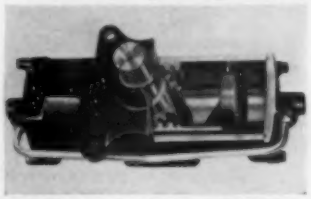
CROSS MANUFACTURING CO.

LEWIS, KANSAS • PHONE 86

New Products / continued

ROTARY MOTION CYLINDER . . . is easy to install

Specifications: Unit can be used wherever hydraulic or pneumatic pressure is available, and offers ease of installation, compactness and efficiency. Operating from 600



to 1000 psi, it delivers 26,000 in-lbs torque. Parameters can be varied to obtain custom installations, and over-running clutches, gears, sprockets, etc., are easily adapted to the output shaft.

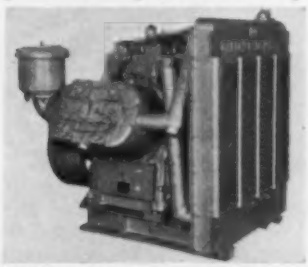
Thompson Products, Inc.
Michigan Div.
Warren, Mich.

Circle 198 on Reader Service Card

AIR COMPRESSOR . . . needs little space

Designation: WBN

Specifications: Unit is 200 hp, two-stage, and requires only 34 square feet of space. Needs no spe-



cial base. Can be bolted down and hooked up to its source of power. Available with tube-type intercooler, or with self-contained radiator-intercooler which saves on cooling water.

Gardner-Denver Co.
Quincy, Ill.

Circle 199 on Reader Service Card

PRECISION INTERNAL GAGE . . . is all-mechanical

Designation: PG-800

Specifications: Unit is entirely mechanical, portable comparator-type, with wide size range from ⅜ to 1½ in. dia., with a reading scale of .005-in. calibrated in 50 millionth graduations. Accuracy is within 20 millionths of an inch. Magnifica-

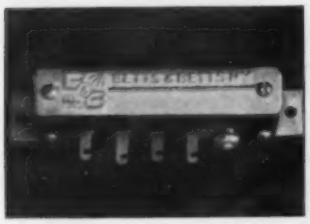
tion is 1000:1 and scale is linear over full range. Movable faceplate allows full exploration of holes up to 3-5/16-in. maximum depth. Gage is rugged, compact, entirely self-contained and requires no air or electric connectors.

Sunnen Service Corp.
St. Louis, Mo.

Circle 200 on Reader Service Card

TIME DELAY SWITCHES . . . operate thermally

Specifications: Delay ranges from 5 to 20 seconds, up to 1 to 5 minutes. Delay can be set at any point within limits of timing range by an adjustment screw which varies the contact gap. Two types are available, one with recycling, the other



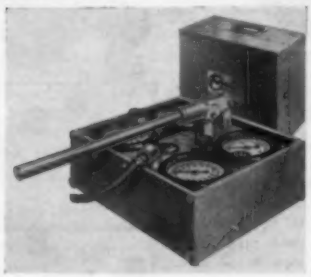
without. Both can be supplied with contacts rated 1 or 2 amps, at 115 volts a.c. Tyipcal units measure 3 x ⅞ x ⅞-in.

Betts & Betts Corp.
New York, N. Y.

Circle 201 on Reader Service Card

HYDRAULIC TESTER . . . is portable

Designation: Porta-Tester
Features: Designed for general industrial use in on-the-site testing of hydraulic equipment to pressures of 3000 psi.
Specifications: Complete with case,



the unit weighs only 55 lbs, and is 18 x 14 x 8-in. Tester is complete with four test-accuracy gages and 8 feet of flexible hydraulic tubing. Pump handle folds flat for easy storage.

Farris Engineering Corp.
Palisades Park, N. J.

Circle 202 on Reader Service Card

Continued on next page

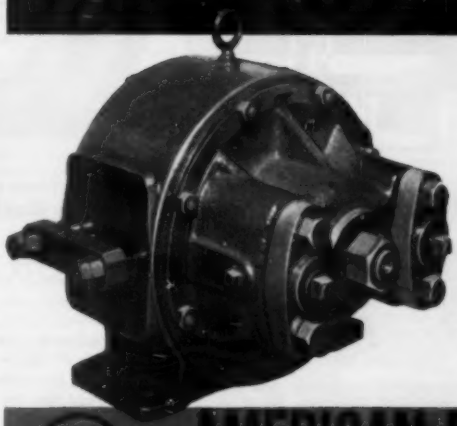
For highest quality
when the pressure's on . . . it's

HELE-SHAW and HYDRAMITE
HYDRAULIC PUMPS

for constant displacement . . .
HYDRAMITE

- Pressures to 5,000 psi
- Capacities of 3, 5, 10 gpm and up
- No supercharging needed
- Efficiencies over 85%
- Either rotation for direct drive

for variable displacement . . .
HELE-SHAW



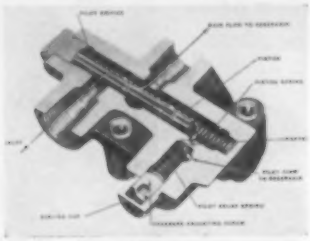
- Instantly reversible
- From 0 to 3,000 psi
- Capacities from 3 to 110 gpm
- Infinitely variable discharge
- Many types of controls

AMERICAN ENGINEERING
COMPANY
Dept. P-141, Wheatsheaf Lane & Sepviva St., Philadelphia 37, Pa.
CANADIAN SUBSIDIARIES: Affiliated Engineering Corporations, Ltd.

New Products continued

PILOT RELIEF VALVE
. . . increases output

Features: Designed for instant reaction, clog-free operation and silence, valve permits about 40% more work than brute-force type.
Specifications: At 1500 psi, pressure differential is less than 7%.



Use of larger orifice prevents clogging. Valve is adjustable from 500 to 2000 psi and has a maximum capacity of 20 gpm.

Webster Electric Co.
Racine, Wis.

Circle 203 on Reader Service Card

DUAL SPEED CYLINDER
. . . saves cycle time

Designation: Thrust-O-Matic

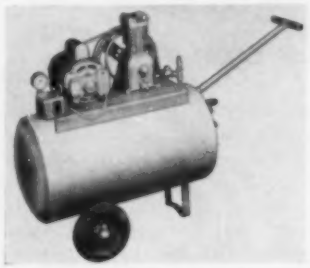
Design: Unit is a three-chambered hydraulic cylinder with valving in head to automatically provide high-speed stroke, power stroke, and high-speed retraction stroke. Two primary, high-speed chambers, opposing each other, are located around a third, or power cylinder. Valving is spring-loaded to a predetermined pressure and operates on pressure differential determined automatically by power demand.
Specifications: Available in any size and cycle ratio, unit is precision-built to prevent warpage, with wear rings located to minimize and simplify maintenance. Operates with a single pump and motor.

Crown Engineering Corp.
Houston, Texas

Circle 204 on Reader Service Card

AIR COMPRESSOR
. . . has built-in silencer

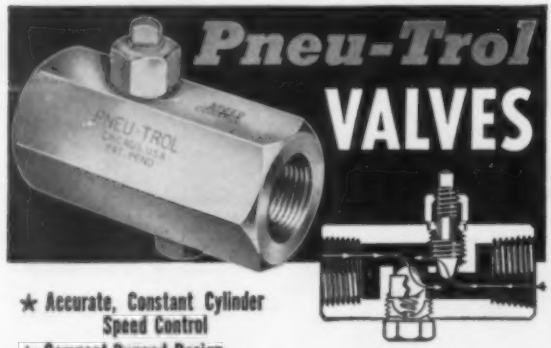
Designation: Model 600
Specifications: Available in portable and stationary models for pressures up to 150 lbs, 350 to 900 rpm, with automatic splash lubrication. Air filter and silencer are



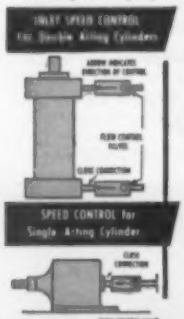
built into the cylinder head. Crankcases are dust tight with no gasket joints below oil level. Cylinder head inlet and outlet are reversible. Automotive type piston has two compression rings and one oil-control ring. Compression ratings are 3.6 cfpm at 60 lbs to 2.8 cfpm at 150 lbs. Powered by ½ hp, single phase, 110/220 volt, 60 cycle motor.

National Compressor Corp.
Chicago, Ill.

Circle 205 on Reader Service Card



★ Accurate, Constant Cylinder Speed Control
★ Compact Rugged Design
★ Simple, Easy Speed Selection ★ For Air, Oil or Water Applications



Pneu-Trol Speed Control Valves are widely used in hundreds of control applications because they combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control and a floating retro ball check, which permits full flow in the opposite direction. Retro ball floats in most sensitive position to its seat, requiring only a slight differential pressure to fully open or close it.

Needle design permits maximum flow capacity in the controlled direction. Metal to metal needle and ball seats insure long trouble-free service. Simple, practical "O" gland structure eliminates troublesome leaking. Valve bodies machined from hex brass or aluminum for 2000 psi working pressures; steel and stainless steel for 5000 psi. Made in 5 female pipe sizes—⅛" to ¾". ATTRACTIVE PRICES . . . IMMEDIATE DELIVERY.

Write for illustrated circular and prices.

Pneu-Trol DEVICES, INC.
1824 N. KEATING AVENUE • CHICAGO 39, ILL.

Circle 103 on Reader Service Card

Satisfaction Guaranteed Or Money Back TRIAL OFFER

TRU-O-SEAL Fittings are guaranteed to seal pipe thread connections permanently against all oils, practically all known chemicals and gases; to seal under high pressures or vacuum; to withstand —280° to plus 500° F.; to eliminate "overtightening" damage and pipe dope. Available in ⅛" to 2½" pipe thread sizes.

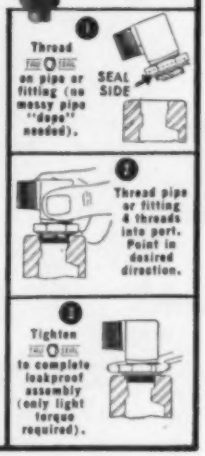
$10.00 Trial Offer No. 1: eight ⅛", ten ¼", eight ⅜", ten ½" pipe thread TRU-O-SEAL Fittings.

$10.00 Trial Offer No. 2: eight ½", ten ¾", four 1" pipe thread TRU-O-SEAL Fittings.

Send order to

TRU-O-SEAL DIVISION
Flick Reedy Corp

2008 N. Hawthorne, Melrose Park, Illinois
"Miller Fluid Power" is also a Div. of Flick-Reedy Corp.


1
Thread TRU-O-SEAL on pipe or fitting (no messy pipe "dope" needed).
SEAL SIDE
2
Thread pipe or fitting 4 threads into port. Point in desired direction.
3
Tighten TRU-O-SEAL to complete leakproof assembly (only light torque required).

Circle 136 on Reader Service Card

Circle 8 on Reader Service Card

Hydraulic CYLINDERS

to specification

AT your service — since 1918 — the most modern machine tools to handle up to 15" I. D., including the last word in honing equipment and the most accurate of precision gauging equipment. Everything we do is to specification. Expanded facilities permit prompt delivery of 1 or 1000 pieces in any material desired.

Call Erie 2-3664 - Send specifications to

AMERICAN HOLLOW BORING COMPANY

1954 Raspberry St., Erie, Pa.

CUT MAINTENANCE COSTS! SAVE DOWN TIME! on your Hydraulic System

Keep it clean *with*

SCHROEDER LINE FILTERS

The Schroeder Line Filter is the answer to keeping harmful dirt from slowing down the operation of your hydraulic equipment. This small, all-in-one unit has a large filtering capacity and removes damaging particles too small to be seen.

Here's why SCHROEDER LINE FILTERS are preferred:

- Filter element costs little and is replaceable.
- Fliptop cap permits minute change of element.
- Designed for space-saving installation.
- Many types and makes of filter elements available.
- Minimum cost for maximum filtration area.
- Element protected by built-in by-pass relief.
- Built-in orifice for partial filtration available.
- Working pressures conservatively rated—each unit shop-tested.

Optional Spin-Dicator provides visual supervision of performance.

SCHROEDER BROTHERS
CORPORATION
NICHOL AVE., BOX 72, McKEES ROCKS, PA.
(Pittsburgh District)
Hydraulic, Electric and Pneumatic Equipment

REDUCE WEAR AND DOWN TIME... Install SCHROEDER LINE FILTERS

Circle 116 on Reader Service Card

Does VOLKSWAGEN bother *Cadillac?*

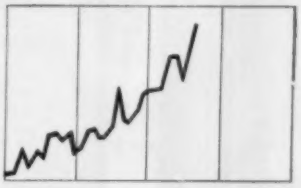
We don't make CADILLAC air cylinders and we don't pretend that we do...

We do claim that we make very good cylinders at very good prices:

BORE	BASIC PRICE	ADD PER " OF STROKE
1⅛"	$15.50	$.35
1½"	$20.50	$.50
2"	$25.50	$.55
2½"	$29.50	$.75
3"	$32.50	$.95
4"	$47.50	$1.20

We furthermore claim that we work hard to ship from stock and our sales chart tells us that we are being successful on all accounts —

PRICE, QUALITY, SERVICE.



Besides cylinders, we also make the ALLENAIR line of AIR VALVES, AIR CLAMPS and DIAL FEED TABLES and if we could tell you right here all there is to tell you about what we offer and how those products can increase your PRODUCTION at MINIMUM COST we wouldn't need the $1.25 47-page catalogue that is available for free this month to anyone seriously interested.

THE A. K. ALLEN CO. AH-10
255 East 2nd St., Mineola, N.Y.
Name .....
Company .....
Address .....
City ..... Zone ..... State .....

P.S.—*The cylinder pictured is a Factory Reject. The only rods available are straight ones and made out of #416 Stainless Steel ground and polished stock and repolished after machining. The bearing is nylon.*

The answer to the question on top of this page is: *Not one bit. There is a market for both!*

ALLENAIR **THE A. K. ALLEN CO.**
255 East 2nd St., Mineola, N.Y.

Circle 5 on Reader Service Card

Useful Literature continued

DOUBLE PUMPS . . . for hydraulic service are described and illustrated in Catalog Section G-114, issued by Gerotor May Corp., Owings Mills, Md. Complete engineering data is given, including drawings of the units and JIC circuits showing their application in hi-lo circuits and two separate circuits.

Circle 246 on Reader Service Card

LIMIT SWITCHES . . . manufactured by Micro Switch, Div. of Minneapolis-Honeywell Regulator Co., Freeport, Ill., are described in Bulletin 84. Two pages show application sketches for process, bulk flow, packaging, motion and lever control, and counting and weighing.

Circle 247 on Reader Service Card

HYDRAULIC POWER UNITS . . . produced by Scott Equipment Co., Dayton, Ohio, are discussed in an illustrated bulletin. Complete engineering data is given, including tables of motor sizes, pumps, reservoirs, and a pump capacity and horsepower chart. Pump types include hi-lo and separate pressure, double vane units, and gear pumps.

Circle 248 on Reader Service Card

CYLINDER TUBING . . . produced by Ohio Seamless Tube Div. of Copperweld Steel Co., Shelby, Ohio, is covered in 12-page booklet IA-6. Booklet shows some of the many uses of seamless and electric resistance steel tubing including applications in lift and tilt cylinders in materials handling equipment.

Circle 249 on Reader Service Card

NYLON PARTS . . . applications to various industries are described in literature available from The Polymer Corp. of Penna, Reading, Pa. Booklet contains many case histories designed to assist engineers in applying nylon parts in their industries. Stories are indexed by standard industrial classifications.

Circle 250 on Reader Service Card

SMALL CYLINDERS . . . for pneumatic and hydraulic service are listed in a bulletin released by Pneumatic-Hydraulic Development Co., Fort Wayne, Ind. Designated Tom Thumb, with ¾-in. to 1⅛-in. bores, the cylinders offer heavy-duty service along with space saving. Complete engineering information is given, with dimensional drawings of all models available.

Circle 251 on Reader Service Card

HIGH-PRESSURE SOLENOID VALVE . . . is available from Automatic Switch Co., Florham Park, N. J. Bulletin 8223 gives complete details and specifications. Units are 2-way solenoid valves designed for service at 1500 psi with tight shut-off.

Circle 252 on Reader Service Card

AIR-AUTOMATED UNITS . . . are described in Catalog No. 101, published by Renco-Toledo, Inc., Toledo, Ohio. Bulletin gives technical descriptions, applications,

BHEW

Custom-Built

HYDRAULIC CYLINDERS

Made-to-order to meet specific design requirements for any application in any industry.

Compactness! Efficiency! Close Tolerances! Outstanding operational performance! You get them all in BHEW cylinders. They require minimum mounting space. There is no tooling charge for BHEW cylinders, built to meet *your* specifications and delivered on schedule.

BHEW cylinders are available in standard and special O.E.M. designs . . . single or double acting and telescopic; 1½" to 8" bore; strokes up to 156"; oil hydraulic service in 1,500 psi or 3,000 psi working pressure, pneumatic up to 150 psi; cup-type, ring-type or O-ring construction; choice of mounting.

1 Cylinder barrel and non-adjustable gland welded into one piece, eliminates joint, makes small O.D. in large single and double-acting hoist cylinders.

2 Accurately honed barrel.

3 Hard chrome-plated rod.

4 Flow regulating or pilot operative check valve in base, when required.

WRITE

for your copy of Hydraulic Cylinder Engineering Reference Data Manual. Can save you hours of time in specifying cylinders. 40 dimensioned basic designs for general and special purpose double acting cylinders.

BHEW **Benton Harbor Engineering Works, Inc.**
422 Langley Avenue, St. Joseph, Michigan

components, specifications and accessories for automation units of rotary, push-pull, drill press feed, and tap-or-drill unit types.

Circle 253 on Reader Service Card

TEFLON SEALED CYLINDER . . . using Teflon for all seals, and operating at hydraulic pressures from 2000 psi to 3000 psi, and 3000 to 5000 psi, is described in a brochure available from Miller Fluid Power Div. of FlickReedy Corp., Melrose Park, Ill. Bulletin gives details of design innovations which made all-teflon sealing possible, and gives complete engineering information and specifications.

Circle 254 on Reader Service Card

TUBING STRESS DATA . . . is given in Bulletin TDC-153B issued by Tubular Products Div., Babcock & Wilcox Co., Beaver Falls, Pa. Fluid power engineers interested in design and application of equipment involving use of tubular products at high temperatures and pressures will find the data of interest. Folder presents the stress rupture data on a number of tubing steels used in such service. Testing temperatures range from 850 F through 1800 F.

Circle 255 on Reader Service Card

SINTERED METAL FILTERS . . . are described and illustrated in 12-page Catalog 54-101, released by Cuno Engineering Corp., Meriden, Conn. Catalog gives characteristics, application data and specifications on porous, sintered, stainless steel filters. A selector chart with instructions, plus filtration data tables, are added to help in filter selection.

Circle 256 on Reader Service Card

AIR REGULATOR . . . filter and lubricator contained in one unit is covered in Bulletin No. 80 issued by Perfecting Service Co., Charlotte, N. C. Complete explanation is given of the working of the unit, along with pictures of the unit and applications.

Circle 257 on Reader Service Card

SWIVEL JOINT . . . manufactured by Chiksan Co., Subs. of Food Machinery & Chemical Corp., Brea, Calif., is illustrated and described in a brochure. Complete engineering information and specifications are given for this swivel joint which is designed for temperatures of 600 F at maximum pressure of 300 psi.

Circle 258 on Reader Service Card

Specify **NUMATICS VALVES**

. . . there are no "equivalents"

MANIFOLDS

DSA34 valves mount interchangeably with all other SA Series air valves on Numatics air and conduit manifolds.

LINE VALVES

Numatics makes a complete line of foot-mounted, line-mounted 2- and 3-way valves, too. Ask for Bulletin #4000.

Today's control demands, particularly in automation applications, require a host of unusual air circuits . . . emergency stop inching circuits, dumping both ends of cylinder to exhaust, pressurizing both cylinder ports, to mention a few. The valves for jobs like these? Numatics spring-centered DSA34 valves . . . the valve series that gives you split-second response, takes pressure surges without sticking or fluttering. Numatics DSA34 valves are offered, what's more, in a wider variety of sizes and actions than any similar valves now on the market. Want more details? Send for Numatics new Bulletin #558A on unusual circuits using 3-position valves.

NUMATICS, Inc.

HIGHLAND, MICHIGAN Dept. AH

Circle 96 on Reader Service Card

Useful Literature continued

3-WAY VALVES . . . for use at extremely high operating pressures, are described in descriptive literature available from Sinclair-Collins Valve Co., Akron, Ohio. Literature covers the complete line of 2 and 3-way valves for use on high-pressure equipment.

Circle 259 on Reader Service Card

SOLENOID VALVES . . . produced by Jackes-Evans Mfg. Co., St. Louis, Mo., are illustrated and described in an engineering bulletin. Units are for pneumatic service mainly, operating at maximum pressure differential of 150 psi. Bulletin covers all features of the line, including mounting in any position, having only two moving parts, and utilizing the principle of pilot port operation.

Circle 260 on Reader Service Card

NO-SKIVE FITTINGS . . . for medium pressure hose are discussed in descriptive Catalog 4434 published by Tube & Hose Fittings Div., Parker Appliance Co., Cleveland, Ohio. Complete information is given on rubber-covered, single wire braid hose and reusable fittings which do not require the hose cover to be skived off.

Circle 261 on Reader Service Card

MACHINE TOOL CONTROLS . . . is the title of a 24-page bulletin issued by True-Trace Sales Corp., El Monte, Calif., for engineers involved in the use of machine tools in aricraft, missile, automotive and other fields. Bulletin is illustrated with photos of continuous and intermittent positioning systems, hydraulic tracers, numerical controls and programming consoles, and also covers hydraulic cylinders, power units, hydraulic milling spindles, coolers and mounting brackets.

Circle 262 on Reader Service Card

SMALL 3-WAY VALVE . . . manufactured by Automatic Switch Co., Florham Park, N. J. is illustrated and described in Bulletin 8314. Unit is a midget size 3-way solenoid valve designed to operate at pressures from zero to 300 psi, with ¼-in. pipe connections, in addition to ⅛-in. connections. Complete engineering information is given, along with dimensional drawing and specifications in convenient chart form.

Circle 263 on Reader Service Card

UNICLOSED MOTOR . . . is described in Bulletin F-1856 published by U. W. Electrical Motors, Inc., Los Angeles, Calif. Details are given on construction features such as drip-proof design, two-way ventilation system. and advanced electrical design. Unit is compact providing space savings.

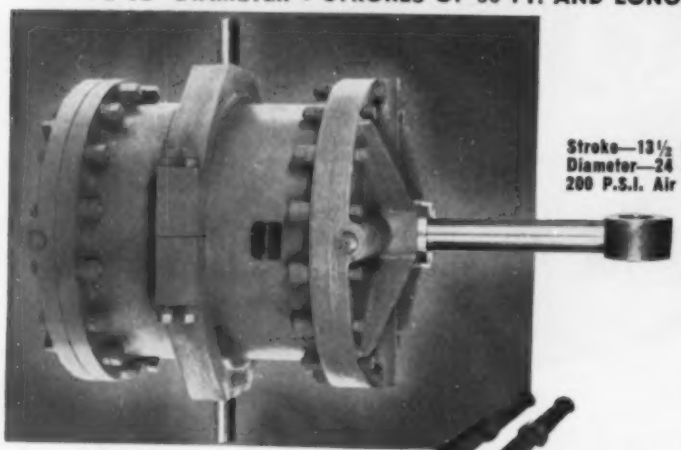
Circle 264 on Reader Service Card

PRESSURE TO 450,000 PSI . . . can be provided by a test unit manufactured by Nucor Research, Inc. Details and specifications are given in Bulletin V-10. Known as the Parabar, this test unit permits research at extremely high pressures.

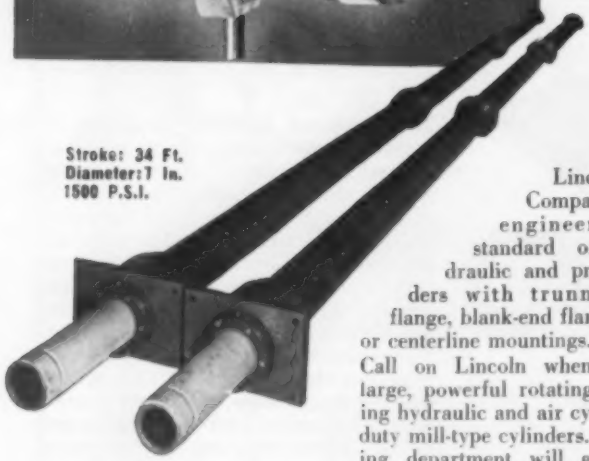
Circle 265 on Reader Service Card

Air & Hydraulic Cylinders

• FOR HEAVY-DUTY APPLICATIONS OF ALL TYPES • TO MEET ALL SIZE AND PRESSURE REQUIREMENTS • BORES TO 32" DIAMETER • STROKES OF 50 FT. AND LONGER.



Stroke—13½ Inches
Diameter—24 Inches
200 P.S.I. Air Pressure



Stroke: 34 Ft.
Diameter: 7 In.
1500 P.S.I.

Write today for Lincoln's catalog. It gives engineering data on many types and sizes of heavy-duty cylinders.

Lincoln Machine Company will design, engineer and build standard or special hydraulic and pneumatic cylinders with trunnion, rod-end flange, blank-end flange, foot, clevis or centerline mountings.

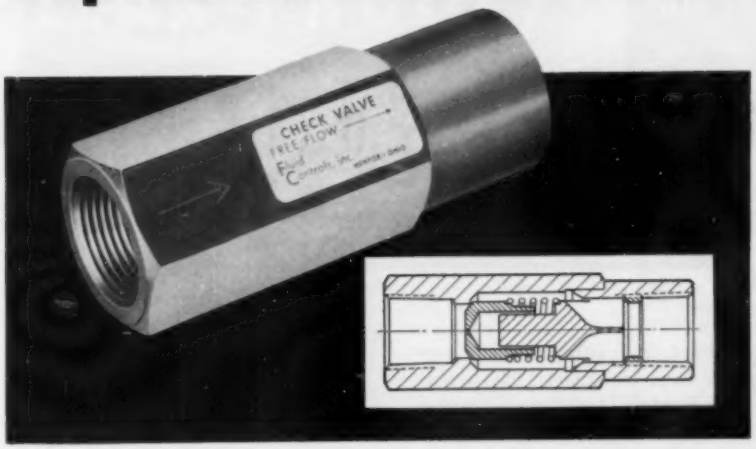
Call on Lincoln when you require large, powerful rotating or non-rotating hydraulic and air cylinders, heavy-duty mill-type cylinders. Our engineering department will give you fast, practical assistance in design problems . . . and our modern plant will build your cylinders quickly and economically.

LINCOLN MACHINE CO. INC.
P. O. BOX 272 • SALEM, OHIO

Circle 79 on Reader Service Card

Circle 44 on Reader Service Card

Dependable Check Valves



- Can't Stick Open
- Low Pressure Drop
- For Oil
- Copper Brazed Steel Bodies
- To 3000 P.S.I. Service
- Pipe Sizes ¼" thru 1¼"

Write for detailed specifications and prices.

Fluid Controls, inc.

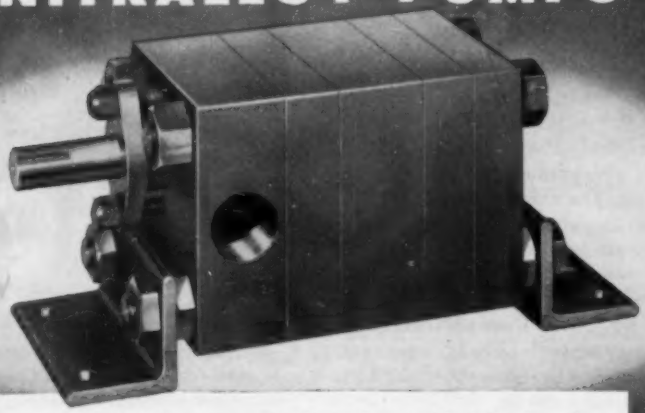
Member of NFPA

Manufacturers of Hydraulic Valves and Devices

Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

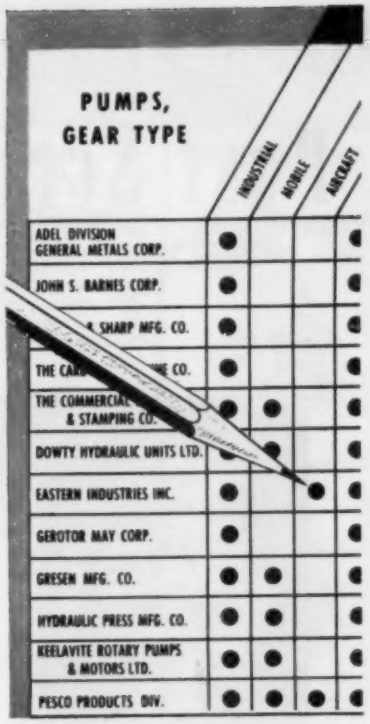
1284 N. CENTER STREET • MENTOR, OHIO

NORTHERN NITRALLOY PUMPS



Unique block construction permits selection from a wide choice of metals for virtually any pumping need. Proven in thousands of installations . . . backed by 50 years of engineering and production experience. Unexcelled for precision manufacture, accurate assembly and dependable, long-life operation. Pressures to 2,000 PSI. Capacities from ¼ to 146 GPM. *Write for free catalog and engineering data.*

NORTHERN ORDNANCE, INCORPORATED
Subsidiary
NORTHERN PUMP COMPANY
MINNEAPOLIS 21, MINN.



Quick with the answers . . .

• • • that's the Designers' Guide Issue of APPLIED HYDRAULICS in January. It provides 34 Quick Guides to Product Selection to help hydraulic design engineers choose fluid power components . . . and a Fluid Power Products Review to help engineers develop new equipment. Make sure your copy is handy!

January Issue

APPLIED HYDRAULICS

Advertisers:

This special issue will be referred to all year 'round, giving your sales message extra readership. A complete name and address index helps readers find your company's ad. Forms close December 5th . . . regular space rates apply . . . order your advertising space today!

812 Huron Rd., Cleveland, O.

Circle 95 on Reader Service Card

Post Scripts of Industry

News about people, manufacturers and sales organizations

Earl C. Davis
Parker Appliance Co.

Harrold J. Rust, Jr.
Lindberg Air & Hydraulic Div.
Teer, Wickwire & Co.

Earl G. Fugett
Cuno Engineering Corp.

Parker Appliance Co., Cleveland, has announced the following: **Earl C. Davis** was appointed sales manager of the industrial hydraulics division; **Myles N. Murray** was made product specialist in the rubber products division; **Robert Soloff, Franklin C. Wolfe Div.** field application engineer, was transferred from Dallas to Cleveland, and will cover northern Ohio, Pittsburgh, western Pennsylvania and Buffalo.

Harrold J. Rust, Jr. has been appointed operations manager of **Lindberg Air & Hydraulic Div., Teer, Wickwire & Co.,** Chicago.

Alpha Molykote Corp., Stamford, Conn. has organized a Technical Services Div. to handle engineering information on their line of molybdenum disulfide lubricants. The new division will be under the direction of **Harry S. Gerstung,** former chief automotive engineer of Sinclair Oil Co. Also announced was the transfer of **Dr. Josef Gaensheimer** from the company's basic research group in Germany to the Stamford laboratories.

Appointment of **Earl G. Fugett** as branch manager of their new sales engineering office at Ardmore, Pa., was announced by **Cuno Engineering Corp.,** Meriden, Conn.

These distributors were appointed by **Parker Appliance Co.,** Cleveland: **Wilson-Wylie Distributing Co.,** 2320 Vinton St., Omaha, Neb—Nebraska and western Iowa; **Louis H. Hein Co.,** 703 Light St., Baltimore—Baltimore area; **Industrial Bearings Co.,** 137 E. Olney Rd., Norfolk, Va.—Norfolk area.

Fluid Controls, Inc., Mentor, Ohio, has announced appointment of two new distributors. **Air & Hydraulics Engineering, Inc.,** an affiliate of **J. T. Suddith & Co.,** 3017 Sixth Ave. South, Birmingham, Ala., covering Alabama, Florida, Georgia, and Tennessee. **Allan T. Shepherd Co.,** 205 E. Canal St., Richmond, Va. covering Virginia, North Carolina, and South Carolina.

Robert L. Rice has been promoted to general sales manager of **Fischer & Porter Co.,** Hatboro, Pa. He was manager of their Water and Waste Div. prior to his appointment.

Opening of southwestern regional sales office has been announced by **Commercial Shearing & Stamping Co.,** Youngstown, Ohio. Located in the Exchange Bank Bldg., Dallas, the office will serve Mississippi, Louisiana, Oklahoma and western Tennessee, in addition to Texas. **Charles J. Butler** is manager of the sales area.

Continued on page 178

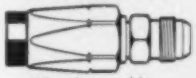
Circle 67 on Reader Service Card

LEAK-PROOF!

REQUIRE NO SPECIAL ASSEMBLY TOOLS

NEW HYDRALINK MALE SWIVEL REUSABLE COUPLING

Male reusable—Rigid



JIC male reusable

JIC female reusable—Swivel

90° Swivel elbow

Permanent coupling assemblies

Hydralink couplings, both permanent and reusable types, are quality units conforming design-wise with national and JIC standards but going a step farther in providing simplified installation and positive leak-proof seals that exceed the demands of peak pressure loads. The new Hydralink catalog is easy to read and helps you select the units you want without cross reference and guessing. Write for it today.

Distributor and Agent territories still available.

HYDRALINK CORPORATION

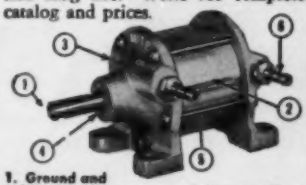
1009 E. 10 Mile Rd.
Hazel Park, Mich.

Circle 3 on Reader Service Card

AIR-MITE AIR CYLINDERS

Low Cost. Compact. Powerful. Rugged.

AIR-MITE Cylinders—made in single or double acting series—in 4 mounting types, are high quality cylinders at a low price. Simple, rugged design and compact construction give them long life, permit easy mounting on jigs, fixtures, tools, or machines. Used wherever power holding, pushing, pulling or lifting is required, AIR-MITE cylinders will meet your most exacting standards of dependability and long life. Write for complete catalog and prices.



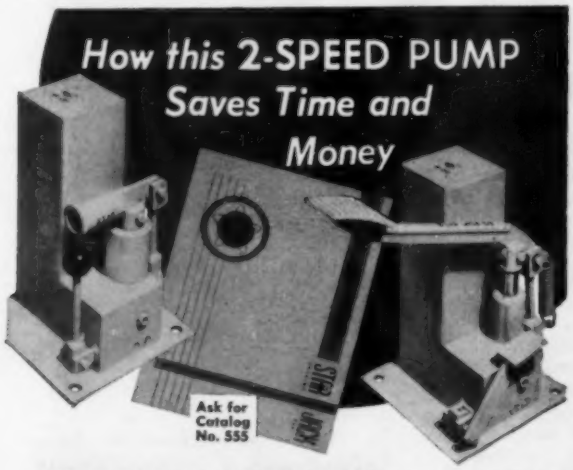
1. Ground and polished steel ram
2. Brass, true-bore cylinders
3. High strength aluminum alloy cylinder heads
4. Bronze oilless ram bushing
5. Five steel tie rods
6. Brass hose stems

4 Mounting Types

AIR-MITE Devices, Inc.

4401 W. KINZIE • CHICAGO, ILLINOIS

How this 2-SPEED PUMP Saves Time and Money



STAR Hi-Lo 2-SPEED PUMP (hand or foot model) operates at high speed, brings ram to load 6 to 15 times faster than a single speed pump, then automatically changes over to high pressure. Maximum capacity 10,000 psi.

SPEEDS WORK, SAVES EFFORT

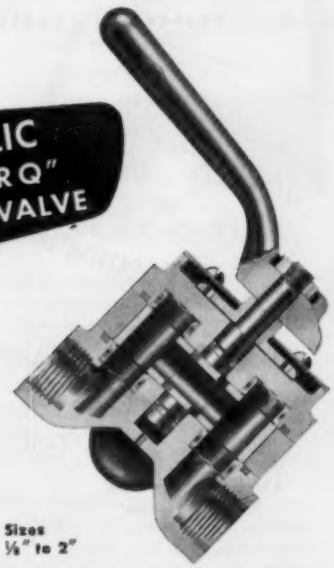
Safety overload valves, oil capacity 160 cu. in. or larger, chrome plated concentric pistons 1¼" and ½", 1½" and ½", 2" and ½", all with 1½" stroke.

Special engineering counsel and proposals cheerfully submitted on request.

Representative areas available.

STAR JACK CO., INC.
420 LEXINGTON AVE., Dept. AH. N.Y.C. 17
PLANT: RIVER GROVE, ILLINOIS

REPUBLIC "LO-TORQ" SELECTOR VALVE



- 0-6000 psi service
- Low turning torque
- Panel mounting
- Semi-steel, bronze, aluminum alloy
- Zero leakage
- 3 types of portings
- Sizes ⅛" to 2"

Write for new catalog No. 654A for complete information.

Distributors in principal cities coast to coast.

201

RM REPUBLIC MANUFACTURING CO.

15655 BROOKPARK ROAD • CLEVELAND 11, OHIO

Circle 6 on Reader Service Card

THERE'S A WORLD OF DIFFERENCE in Bearings

Promet Engineered Bronze Bearings, Bushings and Wearing Parts absolutely will not powder in severest service, nor cut or stick to the shaft because of temporary lubrication failure. They give longer, trouble-free service or your money back.

Write for free literature and service data sheets or send prints and conditions of operation for recommendations and quotations. No obligation.

THE American Crucible PRODUCTS CO.

1303 Oberlin Avenue — Lorain, Ohio, U. S. A.

A Beginner's Course in Basic Pneumatics

Again Available!

First printed in July 1954, 5000 copies of this popular booklet were bought by more than 800 companies and individuals. A second printing completed in March 1957 makes this course available to you.

$1.50 per copy

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ORDER FROM APPLIED HYDRAULICS MAGAZINE
812 HURON ROAD • CLEVELAND 15, OHIO

Post Scripts of Industry continued

Vickers, Inc., Detroit, appointed **F. V. Gieryn** as sales manager, industrial department, machinery hydraulics division. He was formerly manager of export sales.

F. V. Gieryn
Vickers, Inc.

E. J. Doucet, former advertising manager, has been advanced to director of advertising and public relations by **Vickers, Inc., Detroit.**

E. J. Doucet
Vickers, Inc.

Atlas Copco Eastern, Inc., Paterson, N. J. promoted **Duane A. Houkom** to sales manager of the company's stationary compressor division.

The formation of a Power & Package Unit Division in separate 8,000 sq. ft. quarters was announced by **Racine Hydraulics & Machinery, Inc.,** Racine, Wis. **George Verhaeghe,** formerly chief sales engineer of the company, heads the new unit as division manager.

A. H. Cassidy was named industrial sales manager at **Marman Div., Aeroquip Corp.**, Los Angeles, Calif. **M. Lloyd Jones** was promoted to manager, distributors' sales, and **James I. Mellencamp** to manager, marine sales, of the industrial division at Jackson, Mich.

A. H. Cassidy
Marman Div.
Aeroquip Corp.

M. Lloyd Jones
Aeroquip Corp.

James I. Mellencamp
Aeroquip Corp.

Eastman Atlantic Mfg. Co., Atlanta, Ga., has been named a warehousing distributor for **Restoflex Corp.**, Roseland, N. J. Territory will include Alabama, Georgia and Florida.

Continued on next page

What are your

HYDRAULIC HOSE REQUIREMENTS?

FLEX-O-TUBE®

offers the most complete line of Rubber, Teflon* and Synthetic Hose Assemblies and Couplings

CHECK YOUR NEEDS . . .

HOSE	COUPLINGS
One, Two and Three Wire Braid—Rubber Cover	Factory Crimped-on
One Wire Braid—Cotton Cover	Reusable
One and Two Fabric Braid—Rubber Cover	Push-on
Suction	Dynalock Clamp Type
Low Pressure	

—THEN CALL FLEX-O-TUBE

At Flex-O-Tube you'll find the finest and most complete selection of hydraulic system components . . . all manufactured of top quality materials. The inner tube of Flex-O-Tube hose is composed of a seamless synthetic compound resistant to petroleum products, common hydraulic fluids, water and air. A wide variety of reinforcement and outer covering combinations are available.

Flex-O-Tube offers four kinds of fittings and couplings. (See chart above.) These are available in all standard connecting types.

Remember, for all your hydraulic hose and coupling requirements —write or phone Flex-O-Tube First!

When your requirements call for metal, specify Flexon Flexible Metal Hose, available in a complete range of sizes and types.

*Du Pont Trademark *Licensed By Resistoflex Corp.* H-6

FLEXON® QUALITY
proved in service and backed by over 55 years manufacturing experience

Flexonics *Corporation*
FLEX-O-TUBE DIVISION
1385 S. THIRD AVENUE, MAYWOOD, ILLINOIS
FORMERLY CHICAGO METAL HOSE CORPORATION
Manufacturers of flexible metal hose and conduit, expansion joints, metallic bellows and assemblies of these components.
In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

Circle 43 on Reader Service Card

Post Scripts of Industry continued

Henderson Engineering Co., 8047 South Marshfield Ave., Chicago was appointed by **The Sheffer Corp.,** Cincinnati, as representatives in the Chicago area.

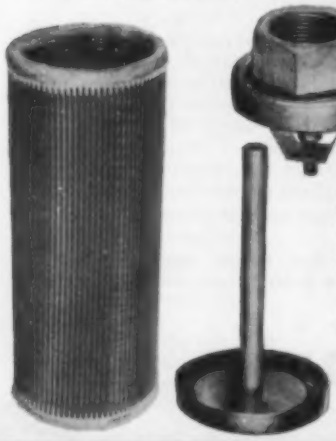
S. Merle Hardison has been appointed district manager in Philadelphia, for **Tube Turns,** Louisville, Ky., a division of **National Cylinder Gas Co.**

Capital

HYDRAULIC OIL FILTER with Monel Metal Insert

Reservoir Type for Hydraulic and Oil Re-circulating Machinery

EASY TO INSTALL—EASY TO CLEAN
LONG LIFE—LOW COST—SIZES AND SCREENS TO FIT YOUR NEEDS



★ ONLY THREE PARTS
★ MEETS J.I.C. STANDARDS
★ GREATER FILTERING AREA
★ SPECIAL TRAP-WEAVE MESH

Specially woven MONEL wire cloth and a new method of compact corrugation, gives triple protection with less space than other filters of like capacity. Trap-weave mesh stops thin, elongated particles with NO loss of efficiency.

Non-corrosive, non-toxic materials throughout. Easily cleaned with an ordinary brush.

Write for descriptive circular.

CAPITAL ENGINEERING & MFG. CORP.

5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

Kenneth W. Finch was made chief engineer of **The Weatherhead Company Fort Wayne Division. Ralph M. Galloway** was appointed as sales engineer.

Kenneth W. Finch
Fort Wayne Div.
Weatherhead Co.

Ralph H. Galloway
Fort Wayne Div.
The Weatherhead Co.

Robert J. Clark has been promoted to secretary of **Weinman Pump & Supply Co.,** Pittsburgh.

Minneapolis-Honeywell Regulator Co. valve division has moved to a new $1.5 million plant in Fort Washington, Pa. The 120,000 sq. ft. facility is located on a 25-acre site in Fort Washington's Industrial Park, 12 miles north of downtown Philadelphia. The valve division is the oldest of the company's units, with a history dating back to 1836.

Devicengineering Co. has moved into new quarters at Media, Pa. New facility will provide space for complete warehousing of supplies.

Ellison Wefel has been named chief engineer of **Anker-Holth Div., Wellman Engineering Co.**, Port Huron, Mich.

M. F. Smith has been appointed New York district manager of **Republic Rubber Division, Lee Rubber & Tire Corp.**, Youngstown, Ohio, with headquarters in the company's eastern sales office at 92 Liberty St. New York City.

Donald W. Benner was named general sales manager of Wilkerson Corp., Englewood (Denver), Colo.

Donald W. Benner
Wilkerson Corp.

Brooks Rotameter Co., Lansdale, Pa., announced a move to a new plant in Hatfield, Pa. **George D. Keller** has been named chief engineer.

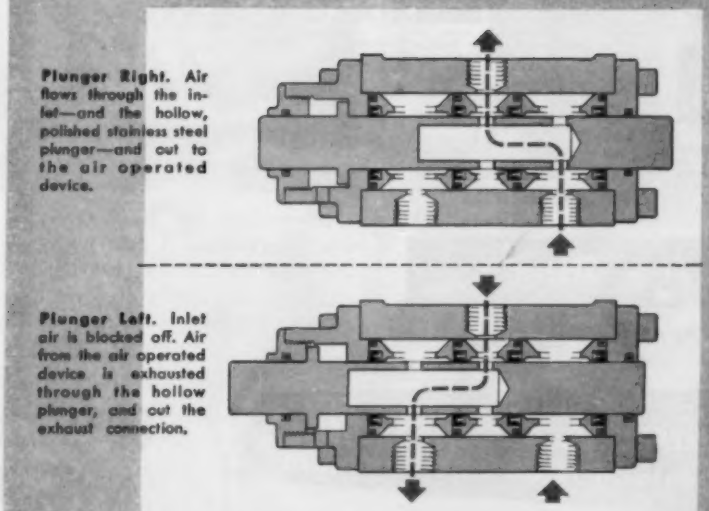
George D. Keller
Brooks Rotameter Co.

Paul A. Roush was appointed as manager, development section, product development department of **Flexible Tubing Corp.**, Guilford, Conn.

Continued on next page

WHO says all control valves are pretty much alike?

This exclusive patented* **Quick-As-Wink®** ***construction***


Plunger Right. Air flows through the inlet—and the hollow, polished stainless steel plunger—and out to the air operated device.
Plunger Left. Inlet air is blocked off. Air from the air operated device is exhausted through the hollow plunger, and out the exhaust connection.

assures users unparalleled efficiency, economy, dependability and satisfaction

Quick-As-Wink Control Valves are in a class by themselves! Our exclusive patented* valve chamber construction, that accurately positions the "O" rings and the "U" packers without mechanical pressure, meets the most exacting service requirements. No direct flow across the packings, greatly prolonging their life. No lapped joints. No metal to metal seating. Hundreds of different types and actions. Sizes from ¼" to 4". Get full details.

*U. S. Pat. No. 2,645,450

Write for BULLETIN NO. 571 Today!

Quick-As-Wink®
AIR AND HYDRAULIC
Control Valves

***Mfd. by* C. B. HUNT & SON, INC., 1995 East Pershing St., Salem, Ohio**

— Engineering and Sales Representatives in the Principal Cities —

Circle 1 on Reader Service Card

SPRING LOADED

This Ring has Everything!

Fall "CJ" WIPER RING

CLOSED JOINT

Here's the ring that gets all the dirt . . . wipes the piston rod CLEAN with every stroke—leaves no tattle-tale streak because it has no open joint.

Spring-Loaded, it has "Squeeze Grip Action," assuring new ring performance . . . automatically takes up the wear. Dry-Lapped at the factory, its wiper edge assures true circle contact . . . Seals Out dirt and even liquids when certain of our rubber seal features are added to the metal portion of ring.

Be sure to specify FALL Wiper Rings. FALL "CJ" Wiper Rings with the closed joint. Available in bronze, stainless steel, cast iron in sizes from 3/16" to 13" dia. If you have a wiper ring problem get in touch with us.

SEALS OUT

SQUEEZE GRIP ACTION

All Fall Rings covered by patents issued or patents pending.

Ace Products Co.

Toledo 1, Ohio Phone Cherry 3-6513

Fall Wiper Ring SPRING LOADED

You Can Depend on ACE PRODUCTS —Established 1935!

Post Scripts of Industry continued

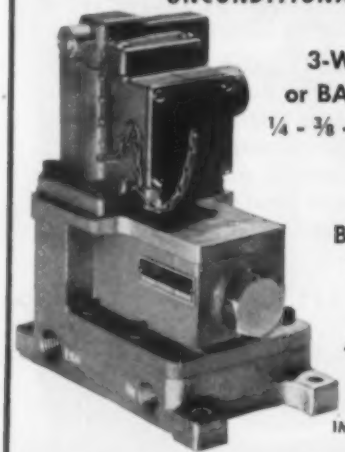
Greer Hydraulics, Inc., Jamaica, L. I., N. Y., has promoted **Leonard H. Seeman** to manager of products sales engineering department.

As part of an over-all expansion of facilities, **Valvair Corporation,** Akron, Ohio, have completed its new product development and testing laboratory.

Stratoflex, Inc. has opened a new branch plant at Fort Wayne, Ind. New facility has 15,000 feet of floor space and is designed to expedite deliveries to the east coast and mid-west. This new plant is under the direction of plant manager **J. C. Nolan,** and is fully equipped to manufacture the complete range of Stratoflex products.

Solenoid Operated AIR VALVES conform to all J.I.C. Standards

Stop Your Solenoid Troubles with AV VALVES Designed & Engineered for Many, Many Millions of Trouble Free Operations & Backed by 1 Year UNCONDITIONAL GUARANTEE



3-WAY IN-LINE or BASE MOUNTED
¼ - ⅜ - ½ - ¾ - 1 - 1¼

• • • •

4-WAY BASE MOUNTED
¼ - ⅜ - ½ - ¾

COMPLETE LINE OF AIR CONTROL VALVES

STOCKING REPRESENTATIVES IN IMPORTANT INDUSTRIAL CENTERS

Write for Bulletin and New Low Prices

AUTOMATIC VALVE CO.
37419 GRAND RIVER AVE., FARMINGTON, MICH.

Foster's AUTOMATIC Quick Detachable Coupler

CUTS YOUR COUPLER COSTS ON HEAVY DUTY WORK

for OIL, AIR and GREASE

Smaller and Lighter Than Most Light-Duty "ball-type" Couplers

THE FOSTERMATIC "BULLDOG" GRIP
"Dogs" are contoured to grip 41% of plug locking surface.

"Dogs" instead of "balls" lock steel against steel . . . hold tighter, without leakage . . . positioned by "floating steel carrier" which absorbs vibration of pulsating air. Chrome sleeve is of stress-proof, heat treated steel to withstand roughest treatment. The Fostermatic is right for 90% of all uses.

Send for New Catalog Data Book #110—No Obligation!

FOSTER MFG. CO., INC.
2850 Gravois 13-C St. Louis 18, Mo.

FOS. 5356

Circle 13 on Reader Service Card

Circle 45 on Reader Service Card

American Machine & Metals, Inc. announced a $2½ million expansion program at its **U. S. Gauge Division** plant at Sellersville, Pa.

George H. Shetlin was named industrial field specialist for **Fort Wayne Div., Weatherhead Co.** He will headquarter in Los Angeles.

Richard A. Powley was named president of Pesco Products Div., Borg-Warner Corp., Bedford, Ohio.

Richard A. Powley
Pesco Products Div.
Borg-Warner Corp.

Robert E. Barnett was promoted to saels manager at **Marsh Instrument Co.**, Skokie, Ill.

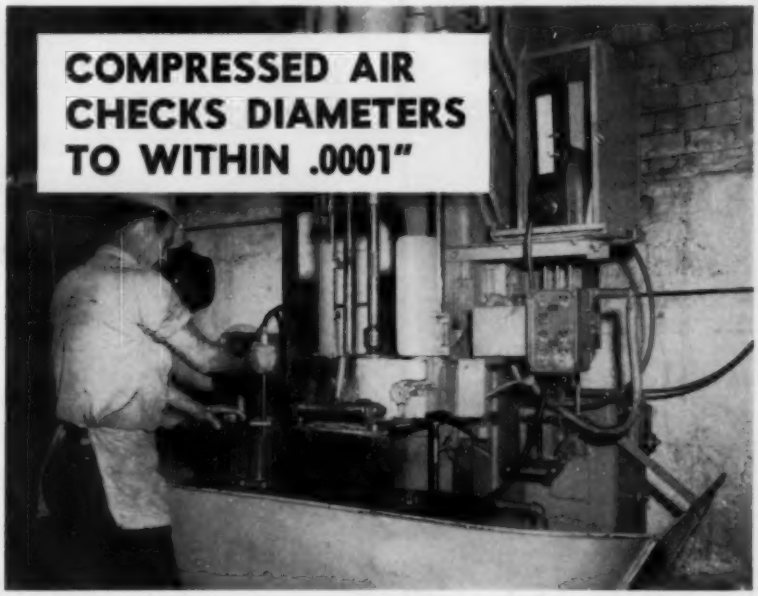
Robert E. Barnett
Marsh Instrument Co.
Skokie, Ill.

Sparta Mfg. Co., Dover, Ohio, is expanding its facilities to increase production capacity. New plant will have air conditioned dip rooms and will use production line techniques.

Dynex, Inc., Pewaukee, Wis. has appointed the following distributors for the Blackhawk hydraulic line: California—**Fornaciari Co.**, 5350 W. Washington Blvd., Los Angeles; Colorado—**Hydraulic Service & Supply Co.**, 5975 Colorado Blvd., Denver; Illinois—**Norman Engineering Co.**, 2115 W. Marquette Rd., Chicago; Indiana—**Scott Industrial Equipment Co.**, 3019 N. Illinois St., Indianapolis, and **Norman Engineering Co.**, 1627 Southeast Drive, South Bend; Iowa—**Norman Engineering Co.**, Davenport; Michigan—**Roberts Engineered Products Co.**, 18130 Fenkell, Detroit; Minnesota—**H. U. Rogness, Inc.**, 135 S. Eleventh St., Minneapolis; Oregon—**Hydraulic & Air Equipment Co.**, 2316 Northwest Savier St., Portland; Wisconsin—**Price Engineering Co.**, 2548 N. Hubbard, Milwaukee.

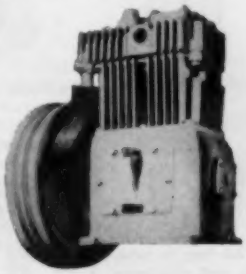
Continued on next page

COMPRESSED AIR CHECKS DIAMETERS TO WITHIN .0001"



Fast precision gaging with compressed air speeds work flow at this critical honing operation. The vertical hone for finishing cylinder walls is equipped with a Sheffield air gage for checking inside diameters, and the air is supplied by a Quincy Compressor. To measure various diameters, the operator has only to change gage plugs. Scale is highly visible, located out of the work area.

Just another example of how Quincy LOW COST AIR POWER can increase the efficiency of machines and manufacturing operations. Quincy makes compressors for industry from 1 to 90 C.F.M. For help with your compressed air applications, address Dept. AH-107.



Quincy COMPRESSORS

QUINCY COMPRESSOR CO. • QUINCY, ILLINOIS

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GROBAN'S

1957 - 1958

HYDRAULICS CATALOG

Featuring

SURPLUS

- **Pumps • Valves • Cylinders**
- **Accumulators, Hose, Fittings, Gauges**

AT MONEY-SAVING PRICES

LARGE QUANTITIES! IMMEDIATE DELIVERY!

ORDER YOUR — COPY TODAY —

GROBAN SUPPLY CO.

GROBAN BLDG.
1141 So. Wabash Ave.
Chicago 5, Ill.

Post Scripts of Industry

continued

Ortman-Miller Machine Co., Inc., Hammond, Ind. has appointed **Marshall & Williams Equipment Co.,** Greenville, S. C. as exclusive representative in North Carolina and South Carolina.

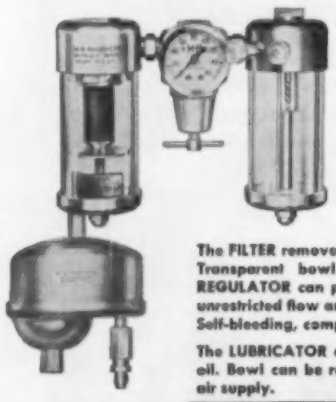
Ontor Ltd., 12 Leswyn Rd., Toronto, Canada, was appointed distributor for **Ledeen Mfg. Co.** Territory includes all eastern Canadian provinces except British Columbia and Alberta.

The Rucker Co., Oakland, Calif., has completed an addition to the manufacturing area, bringing total office, manufacturing and storage area to 38,000 sq. ft. Building has been designed exclusively for the manufacture and fabrication of large hydraulic and pneumatic systems. Additional features include a hydraulic test area.

GREATER PROTECTION to your AIR LINE!

M·B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)



SUCCESSFULLY USED FOR PROTECTION OF AIR VALVES CYLINDERS CONTROLS PNEUMATIC TOOLS, ETC.

The FILTER removes solids .00039 and larger. Transparent bowl provides visibility. The REGULATOR can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

The LUBRICATOR delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The Air Trap is automatic and eliminates manual draining.

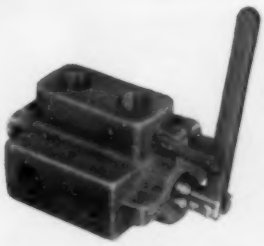
M·B PRODUCTS
46 VICTOR AVE., Dpt. 18 DETROIT 3, MICHIGAN

DOUBLE SELECTOR VALVE

GRESEN HYDRAULICS

A NEW GRESEN PRODUCT NOW AVAILABLE

Model DS-75



FEATURES: Cast iron body—pressure balanced spool—Easy to mount—Chrome plated spool—Optional three handle positions.

SPECIFICATIONS: Capacity—24GPM @15 ft/sec.
Pressure range —0 to 1500 PSI
All openings—¾" NPT
Shipping weight—12 lbs.

Write for literature

GRESEN MANUFACTURING CO.

405-35th Ave. N. E. Dept. A-107 Minneapolis 18, Minn.

Circle 85 on Reader Service Card

Circle 54 on Reader Service Card

Metropolitan Supply Co. is now doing business at their new office and warehouse, 1153 South Greenwood Ave., Montebello, Calif.

R. E. Esch, general manager of **Vickers, Inc.** international division, was named a vice president. **Frank L. Moncher** was appointed as director of engineering, Aero Hydraulics Div. Two industrial hydraulics application engineers were appointed: **George C. Nordenholt,** Springfield, N. J. office; Harry H. Carlson, Cincinnati office.

R. E. Esch

Frank L. Moncher
Vickers, Inc.

Martin-Decker Corp., Long Beach, Calif., announced appointment of **Jack W. Knowlton** as sales manager.

Clark Controller Co., Cleveland, has opened a district sales office at 122 Second Ave., San Mateo, Calif., to serve the San Francisco area, with **David J. Belock** as manager. **Worley R. Stout** has joined their Pittsburgh office sales staff.

Continued on next page

Uses: For pressure lubrication lines, hydraulic and pneumatic systems, oil and fuel lines, chemical and food processing lines, vacuum system connections, etc.

Advantages: Handles high pressures at low cost. Long life under continuous flexing and vibration. Tough, abrasion resistant. Low minimum bend radius. Crush resistant—won't collapse. Inert to hydrocarbons, oils, greases, synthetic hydraulic fluids, most solvents and alkalis. Odorless, tasteless, non-toxic, fungus resistant. Wide service temperature range. Applicable to standard flare and flareless fittings. Easily cut, flared, installed around existing equipment, requiring no pre-bending, flexible couplings or intermediate fittings.

Product of U.S.G's new, ultra-modern Nylon-Teflon Extrusion Plant—new and exclusive techniques and facilities.

Write for further information.

United States Gasket Company
Camden 1, New Jersey

United States Gasket *Plastics Division*
OF THE GARLOCK PACKING COMPANY

Circle 141 on Reader Service Card

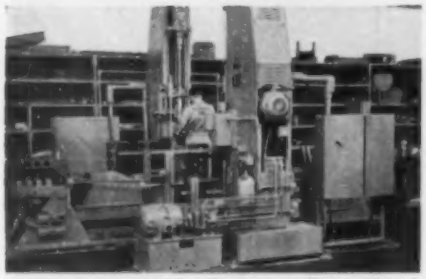
Post Scripts of Industry
continued

Young Radiator Co., Racine, Wis., has appointed **Stanley M. Proctor Co.** as representatives for their heat exchanger division for northern Ohio.

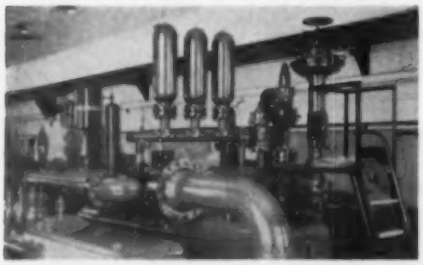
Minneapolis-Honeywell Regulator Co. has leased a new $300,000 plant in Fall River, Mass., as a manufacturing unit of their industrial division.

PROBLEM IN HYDRAULICS?

Case Histories Prove Greer Accumulator Most Versatile Hydraulic Component Ever Devised!



HONING MACHINE. Costly work spoilage reduced by Greer Accumulator absorbing shock each time honing spindles reverse direction.



PIPELINE PUMP. Failure and damage to system eliminated when Greer Accumulators cut surges 53%. Works same way on valve closures.

HANDLING EQUIPMENT. Greater production through faster operation with fewer customer claims for damaged goods and spillage by Greer Accumulator eliminating harmful shock.

If your equipment is operated hydraulically, it is a proven fact that the Greer Accumulator can cut costs, improve performance, reduce size, weight and complexity of your machines.

If you are planning a new product or improving a present one, now is the time to let Greer engineers give you technical assistance and recommendations without obligation.

U. S. Patents under Olaer Licenses

Write for Bulletin PR-200 for complete accumulator data and diagrams today.

GREER HYDRAULICS INC. • NEW YORK INTERNATIONAL AIRPORT • JAMAICA 30

Automatic Switch Co., Florham Park, N. J., has appointed these stocking distributors: **Morristown Electrical Supply Co.,** 23 Spring St. Morristown, N. J.; and **Air & Hydraulic Equipment Co.,** 86 Hudson St., Hackensack, N. J.

Arthur W. Byxbee has been promoted to general manager of **Raybestos-Manhattan's** Paramount, Calif. plant. **Howard H. Herr, Jr.** succeeded Byxbee as sales manager of their plastic products division at Manheim, Pa.

Arthur W. Byxbee
Raybestos-Manhattan, Inc.

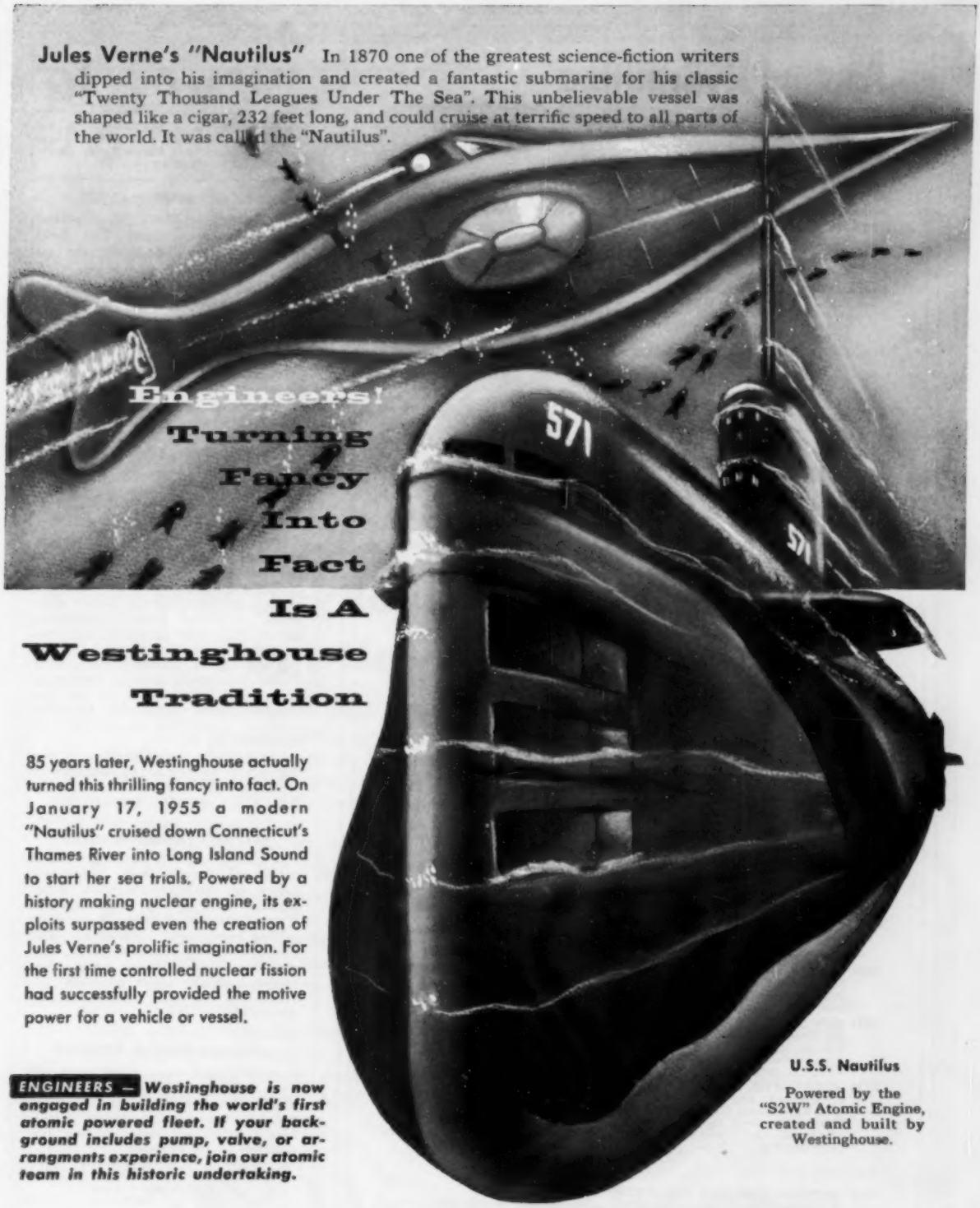
Howard H. Herr, Jr.
Raybestos-Manhattan, Inc.

Tuthill Pump Co., Chicago, has appointed **Misco,** S. A., Dr. Vertis 12, Mexico 7, D.F., as their exclusive sales representatives for Mexico.

Midcontinent Tube Service, Inc., has moved to new facilities at 2120 Lee St., Evanston, Ill.

Hydro-Line Mfg. Co., Rockford, Ill., has appointed **G. Cameron Harvey** to its application engineering staff.

Jules Verne's "Nautilus" In 1870 one of the greatest science-fiction writers dipped into his imagination and created a fantastic submarine for his classic "Twenty Thousand Leagues Under The Sea". This unbelievable vessel was shaped like a cigar, 232 feet long, and could cruise at terrific speed to all parts of the world. It was called the "Nautilus".



Engineers! Turning Fancy Into Fact Is A Westinghouse Tradition

85 years later, Westinghouse actually turned this thrilling fancy into fact. On January 17, 1955 a modern "Nautilus" cruised down Connecticut's Thames River into Long Island Sound to start her sea trials. Powered by a history making nuclear engine, its exploits surpassed even the creation of Jules Verne's prolific imagination. For the first time controlled nuclear fission had successfully provided the motive power for a vehicle or vessel.

ENGINEERS — ***Westinghouse is now engaged in building the world's first atomic powered fleet. If your background includes pump, valve, or arrangments experience, join our atomic team in this historic undertaking.***

U.S.S. Nautilus

Powered by the "S2W" Atomic Engine, created and built by Westinghouse.

Submit your resume to:
Mr. John D. Batey

Westinghouse
ELECTRIC CORP.

First in Atomic Power

Dept. M-16, **P.O. Box 1047, Pittsburgh 30, Pa.**

Applied Hydraulics

THE MAGAZINE OF FLUID POWER

REPRINTS

The following reprints of articles which have appeared in APPLIED HYDRAULICS Magazine are available. Please order by number, enclosing the exact amount in coins, stamps or check. Send all orders to: APPLIED HYDRAULICS MAGAZINE, 812 Huron Road, Cleveland 15, Ohio.

AVAILABLE AT 10c:

R101 DETERMINING PUMP AND ACCUMULATOR SIZE FOR ELECTRO-HYDRAULIC SERVOMECHANISMS . . . By Paul E. Straight
Selection of pumps and accumulators including special factors to be considered in a servo system not encountered in other industrial applications.

R102 FIRE-RESISTANT HYDRAULIC FLUIDS—PART 2 AQUEOUS BASE TYPES . . . By W. H. Millett
Discusses the properties of these fluids and their installation and control.

R103 SPECIFYING HYDRAULIC TUBING . . . By Louis F. Calzi
What to check when specifying tubing to avoid leakage due to cracks from vibration and pressure surges.

R104 HOW TO SELECT A FLUID POWER PACKAGE FOR MOBILE EQUIPMENT . . . By Rodger Lovrenich
Covers design considerations and solution using a small vane pump which proved more economical than a large one.

R105 AIR CONTROLS OIL CIRCUITS ON A 2000-TON PRESS . . . By S. H. Durbin
Describes use of air for pilot operation of large hydraulic directional control valves for faster action.

R106 WHAT'S TITANIUM'S FUTURE IN AIRCRAFT HYDRAULIC CIRCUITS . . . By Don F. Collins
Cost per pound of weight saved warrants consideration for its use in fittings. Performance and service life are equal or superior to other materials.

R107 DESIGN OF A CONTINUOUS DISPLACEMENT BOOSTER PUMP . . . By Eric Nord and Elmer F. Heiser
Describes a two-piston power unit which can be used as a pump or booster on water or oil systems to 2500 psi.

R108 DESIGN OF A HYDRAULIC POWER UNIT FOR A MULTI-STATION TRANSFER MACHINE . . . By Joseph H. Cohen
Covers the design of the hydraulic power unit to meet tight specifications and space limitations.

R109 FLUID POWER IN THE HOME . . . By Edward L. Bronstein, Jr., and Richard A. Fisher
Application of fluid power to a sofa bed is described, giving drawings and schematic of the hydraulic circuit.

R110 ELECTRO-HYDRAULIC SERVO SYSTEMS . . . By J. Wesley Broome
Itemizes questions to be answered in design and application of electro-hydraulic servo systems.

R111 COMPARING CAM AND SOLENOID-OPERATED FEED CIRCUITS . . . By E. H. Gatwood
Three different methods are shown schematically for providing a transition from rapid advance to feed, with check valves for obtaining rapid return.

R112 CHANGING TO FIRE-RESISTANT FLUID . . . By J. R. Homeon
Gives valuable information on change-over, including eight steps to insure longer service life and lower costs.

R113 PISTON RINGS FOR HYDRAULICS . . . By Ernest J. Taschenberg and John W. Pennington
Discusses effectiveness of metallic piston ring seals for sealing reciprocating hydraulic pistons and gives basic information on their development and effective use.

R114 BONDED SEALS—HOW AND WHERE TO USE THEM . . . By John A. Lankester
Information on the various types used and applications for both aircraft and industrial use.

R115 HOW TO APPLY CLOSED LOOP HYDRAULICS TO MACHINE TOOLS . . . By Paul Maker and E. L. Dix
Use of closed loop circuits provided improved response, reduced cycle time, reduced operating force to improve accuracy, and controlled vibration to improve finish.

R116 HYDROSTATIC TRANSMISSIONS FOR CONSTRUCTION . . . By Sterling F. Winchell; and DUAL FLUID MOTORS FOR TWO-SPEED CONTROL . . . By William M. Shook
Covers the trend toward increased use of hydraulics in construction equipment, and shows use of two dual gear motors to drive the tracks of a grading machine.

AVAILABLE AT 25c:

R120 GROWING HORIZONS FOR FLUID POWER . . .
A 32-page report covering trends in design and application of fluid power.

R121 TEMPERATURE CONTROL IN HYDRAULIC SYSTEMS . . . By Allan E. Morris
A complete report on latest developments. 16-pages of data on heat generation, fluids and packings, heat dissipation, system design, oil coolers, immersion heaters and automatic temperature control.

AVAILABLE AT 50c:

R122 AIR AND OIL CIRCUIT GUIDE . . .
Contains 32-pages of basic circuits for pressure control, speed control, and other applications.

THE MARKET PLACE

When replying to a box number in the Market Place, address your letter to Applied Hydraulics, 812 Huron Road, Cleveland 15, Ohio. Attention: Box No.

DISTRIBUTORS WANTED

Distributors wanted for patented Metallic Rod Wipers. The Seal Guard is standard equipment on several makes of pneumatic and hydraulic cylinders. We have a national distribution program in progress with several exclusive territories open. Submit resume of lines carried, territory covered and experience in the hydraulic and pneumatic field. See our ad on page 159 of this issue.
Mail replies to: HYDRAULIC ACCESSORIES COMPANY, 24301 Hoover Road, Van Dyke, (Detroit), Michigan. Attention Mr. T. W. King Sales Manager.

TECHNICAL SALES or LIAISON

Advertiser with 24 years design experience including aircraft hydraulics and control gear, aircraft undercarriage layout and design, electrical control gear, heavy electrical rotating plant, substation layout etc., with 12 years Sales experience in the Industrial field, 4 years Ontario, Canada, contacting Plant Engineers, desires Technical Sales or Liaison work in the hydraulic field. Territory Ontario, Canada. Technical experience obtained in U. K.
Alternatively, consideration is being given to the establishment of Hydraulic Sales Agency. Replies to Box 21057 APPLIED HYDRAULICS.

REPRESENTATION WANTED

Philadelphia firm seeking Pneumatic, Hydraulic, and Electronic Lines in conjunction with automation and special machinery. Engineering service available. Now selling industrial, chemical, and manufacturing plants in N. J., Pa., and Del. Send catalogs, prices, discounts and any other pertinent information to Box 11057 APPLIED HYDRAULICS.

AN HARDWARE & FITTINGS

Stainless, Aluminum, Brass, Steel. All sizes—immediate delivery from world's largest shelf stock. Buy direct from manufacturer. Lower prices—quicker service. Send for free wall charts showing complete line of AN Fittings.
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Culver City, California

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Westinghouse Men of Vision Plan New Atomic Fleet

First it was the *Nautilus*. Now Westinghouse is working on nuclear power plants for more units in the growing U.S. atomic fleet. Here is a chance for engineers to put their present knowledge to work on the ground floor of a new and growing industry . . . where they will be helping to guarantee the future of their country at the same time they are guaranteeing their own future.

Engineers in Westinghouse Atomic Power have assignments covering a broad range in the field of nuclear propulsion components . . . from specifications through manufacturing and test follow-up . . . to installation and operations.

No delay for security clearance; you can start working at once. Relocation allowances . . . and unique housing bureau will help you relocate in Pittsburgh, the renaissance city of America. Automatic salary increases, in addition to merit increases.

No prior atomic experience is necessary. If you have a background in pumps, valves, heat transfer, fluid systems, technical procurement, or manufacturing engineering liaison, send résumé to Mr. J. D. Batey, Westinghouse Electric Corporation, Dept. AHK-107, Box 1047, Pittsburgh 30, Pa.

Westinghouse

FIRST IN ATOMIC POWER

. . . where atoms go to sea

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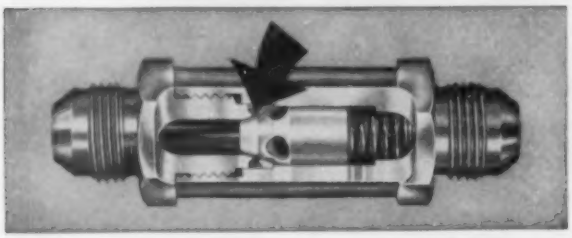
Simple, Secure . . . Leak-Tight!

The FLEXIBLE SEAL SEAT*



Responsive action of the soft O-ring seal provides absolute leak-tightness. Instantly compresses to seal internal and external pressures. Draws harmlessly around dirt particles. No costly precision parts; no extra end seals. Stocked in 6 standard Dryseal pipe and JIC tube sizes; 12 connection combinations. Write for data sheet.

KEPNER PRODUCTS COMPANY
7321 West 59th Street • Summit, Illinois

Kep-O-seal

HYDRAULIC & PNEUMATIC
CHECK VALVES

* PATENT APPLIED FOR

BACHMAN 4-WAY

5-PORT VALVE
S-845 110 V.
$16.75

For control of double acting cylinders, separate exhaust ports give speed control in either direction or, if center port is used for exhaust, high and low pressures may be used for power and return cycle.

Thousands Now Used and Approved by Leading Industries

Bachman valves get quickest acceptance from top-flight engineers! They find significant savings and new standards of dependability for large capacity, direct acting valves. Performance proves continued speed and efficiency after millions of cycles.

Illustrated model has 5/16" diameter orifice, ¼" pipe ports, is 8" long and weighs 2 lbs. Inrush current 4 amperes, holding 25 watts. Pressures to 200 psi. Other models and ½" pipe size valves also shipped from stock.

Winner of 1957 Materials and Methods Design Award

Light weight phenolic laminate and aluminum construction cushion shock and provide amazing durability in rapid cycling operations.

Try one of these valves for 30 days in your plant without obligation. Complete engineering specifications sent free of charge.

JOHN D. BACHMAN & COMPANY
1713 SPARGER LANE • BRISTOL, TENNESSEE

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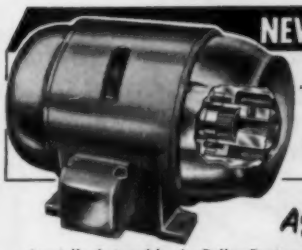

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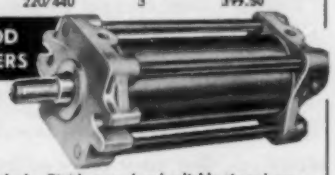

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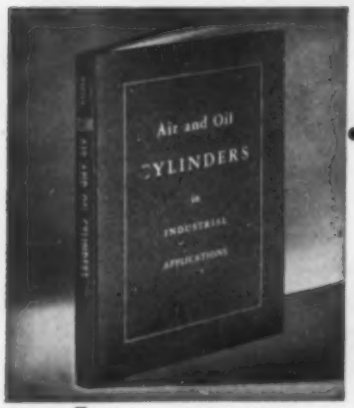

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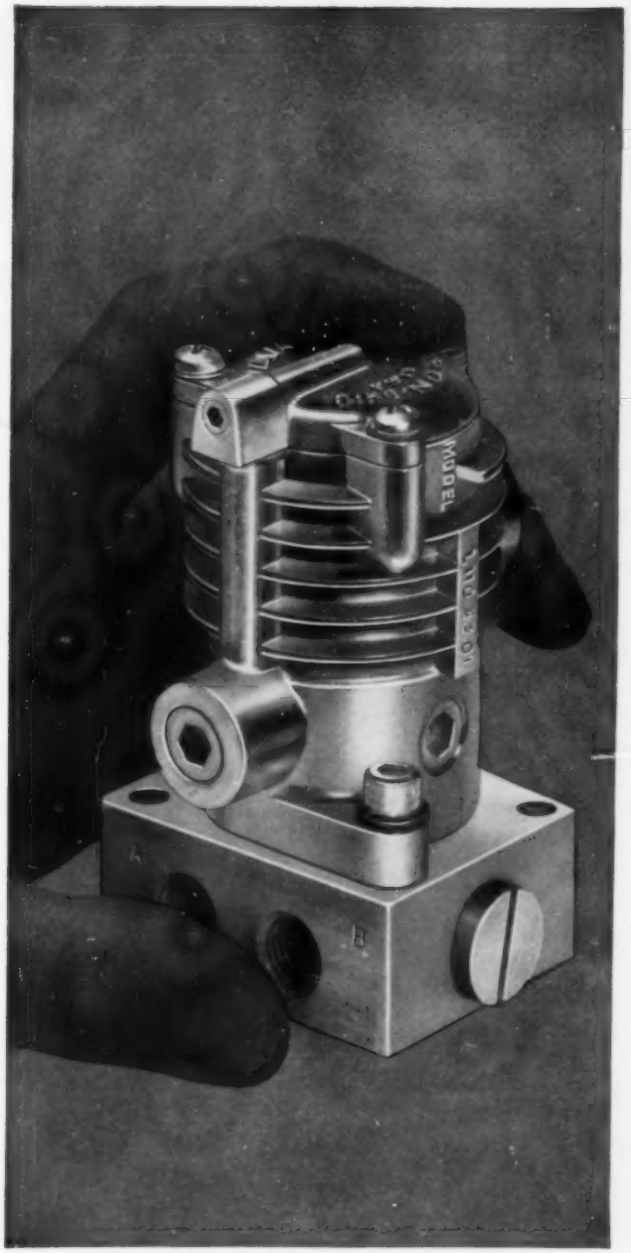

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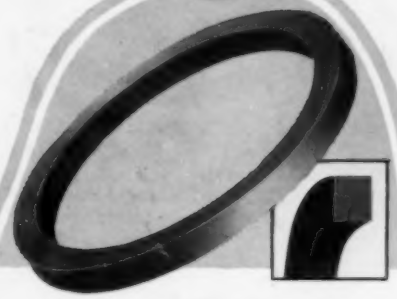

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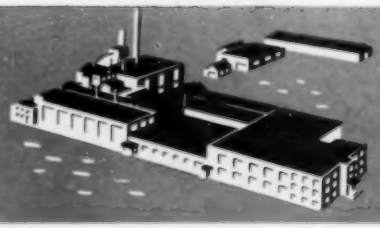

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